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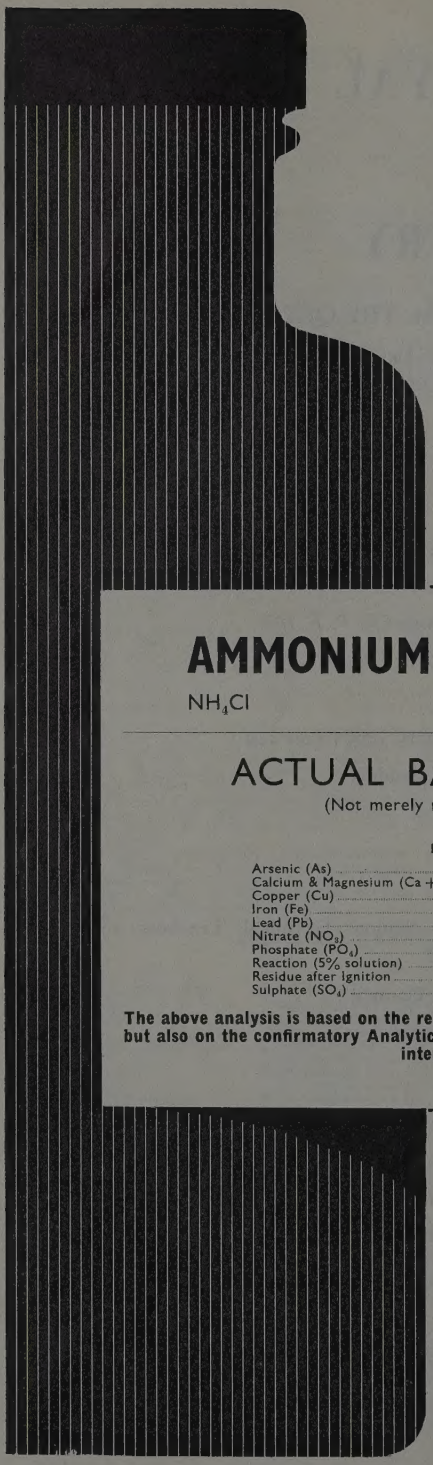

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BOOKS AND BIRTHDAYS

Anniversaries delight the young but, as the years creep on, we tend to neglect—even forget—them. Religious and national occasions have today become commercialized, schools annually pay homage to their founders, and birthdays come and go with celebration appropriate to the occasion. Ultimately there comes a time when, at first unintentionally and then intentionally, we care to forget the passing years. Robert Louis Stevenson, at the age of 40, felt he had no further use for a birthday of any description and transferred his 'with all its rights and privileges' to a small girl who was born on Christmas Day and who was, he felt, defrauded of her natural rights to a private anniversary. Some, like a batsman at the wicket, survive until the scoring board records a century and the occasion is applauded by friends and spectators.

'In books,' wrote Carlyle, 'lies the soul of the whole Past Time; the articulate, audible voice of the past. . . .' Many books are unworthy of remembrance; a few are now regaled as 'classics.' In the sciences, as knowledge increases and new books or new editions appear in ever-increasing numbers, the old retain but little value. Books, too, have birthdays or dates of publication, and some of these may provide occasions for celebration.

> 'For out of olde feldes, as men seith,
> Cometh al this newe corn fro yeer to yere;
> And out of olde bokes, in good feith
> Cometh al this newe science that men lere.'
>
> *Chaucer*

A hundred years ago this year Dr Muspratt published his *Chemistry Theoretical, Practical and Analytical, as applied and relating to the Arts and Manufactures*—a work of over 1700 pages, which provides a comprehensive review—almost the charter—of the chemical industry of that period.

James Sheridan Muspratt was born in Dublin on 8 March, 1821. His father, James Muspratt, a man of considerable enterprise, who at the age of fourteen had been apprenticed to a wholesale chemist and druggist in that city, set up business there in 1814 as a chemical manufacturer and later practised in Liverpool, St Helens, Widnes and Flint. In the year 1837, when the British Association meetings were held in Liverpool, he met Justus von Liebig, the German chemist who was one of the celebrated foreign guests attending the meeting. Liebig's work both as a teacher and as a director of research was attracting students to Giessen from all parts of the world. Sheridan was the eldest son of a large family, four of whom succeeded their father in the family business. He inherited his father's interest in chemistry and received his early training from Professor T. Graham at Anderson's University, Glasgow. In 1843 his father sent him to Giessen where he was followed by his brothers Frederic and Edmund (a very generous benefactor to the University of Liverpool). There, under the supervision of Professor Liebig, he carried out some excellent research work on sulphites (work which earned for him the degree of Ph.D.); later, under Professor A. W. Hofmann at the Royal College of Chemistry in London, he worked on toluidine and nitraniline. The high standard of his researches merited his election to the Fellowship of the Royal Society.

Dr Muspratt's travels were extensive, including a visit to America to gain experience in business methods. In 1848 he married the beautiful American actress Miss Susan Cushman who, with her sister Charlotte, was a frequent visitor to his father's home but unfortunately the marriage was brought to an untimely end with her death eleven years later. In the year of his marriage, he founded the Liverpool College of Chemistry on the same lines as the London College where he had studied under Hofmann; he himself was Principal of the College, which aimed at providing opportunities for the practical teaching of chemistry, and classes were held first over a stable behind his residence in Canning Street and subsequently in Duke Street. In this college 'a good chemical education was given and several of the students obtained positions in works and mines both in this country and the Colonies.' Nine years later he succeeded to a share of his father's industrial business at Widnes and Flint. He was already, at that time, author of many papers, and from 1854 to 1860 he devoted much time to editing the comprehensive dictionary referred to above. In the second volume, as editor, he congratulates himself and his readers that his arduous but not unpleasant labours are at length brought to a close and 'acknowledges the cordial support which he has received from eminent scientific men, manufacturing chemists and also from non-professional subscribers.' Dr Muspratt died at Liverpool on 3 April, 1871.

The work, published in two volumes by 'William MacKenzie, Printers of London, Glasgow and Edinburgh,' appeared in several English editions and was translated into German by Dr Stohman. Undoubtedly this was the highest compliment that could have been paid to it, for Germany was at the time leading the world in chemical industry and translations were almost entirely in the opposite direction. Each volume opens with a number of beautiful steel engravings of eminent scientists, such as Gay-Lussac, Lavoisier, Dalton and Faraday. In the course of the text many topics dealing with both organic and inorganic chemistry are discussed in alphabetical order, in such a way as to interest not only the chemist concerned with manufacturing processes but also the purely academic chemist. For

example, he deals with the chemistry and metallurgy of the then known metals, the properties of many organic compounds such as chloroform, ether and opium, the making of bread, butter and cheese, of glass, paper, perfumes, pottery and candles; he describes techniques such as dyeing, calico-printing, the tanning of leather and distillation. The articles are well illustrated and frequently shed light on the life of the period. Thus, while dealing with the subject of distillation he makes reference to unlawful distillation as practised in Ireland: 'The spirit of these illicit stills has long been a favourite beverage in Ireland being from malt without adulteration and possessing a flavour which habit has rendered most agreeable.'

As we turn the pages 'the soul of the whole Past Time' is revealed and we see the beginnings of the vast chemical industry of today. May we, this year, acknowledge James Sheridan Muspratt and the work which he published a hundred years ago.

D. B. STRATHDEE

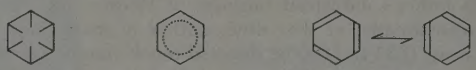
Journal of the Royal institute of chemistry. 84, 90-94, 1960.

AROMATIC CHARACTER

By A. W. JOHNSON, M.A., SC.D., A.R.C.S., F.R.I.C.*

Sir Jesse Boot Professor of Organic Chemistry, University of Nottingham

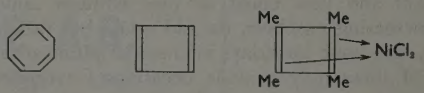
THE unique properties of the benzene ring are well known to all elementary students of organic chemistry, who usually distinguish aliphatic and aromatic compounds in their first two terms of lectures. The word aromatic, as applied to an organic molecule, is generally used to denote the presence of a benzene ring, or a condensed system of benzene rings, which is remarkably stable in chemical reactions and is not easily destroyed. The reasons for the stability associated with the benzene ring have interested chemists for many years, and the representation of the double-bond system within the ring went through several phases (*e.g.* I, II) before the familiar Kekulé structure (III) was eventually adopted.



(I) (II) (III)

Armstrong-Baeyer, 1887 Thiele, 1898 Kekulé

Theoretical considerations of the stability of the benzene ring likewise go back many years. From Bamberger's association of these properties with six residual affinities,[1] there arose Robinson's theory of the aromatic sextet of electrons[2] and finally the molecular orbital treatment of the benzene molecule by Hückel,[3] who connected aromatic stability with the presence of $(4n+2)$, *i.e.* six, but not four or eight, π-electrons in a closed ring system. These theories offered both a stimulus and a challenge to experimental organic chemists, for apart from benzene, only one of these ring systems containing alternate single and double bonds was known at that time (*see* reviews of non-benzenoid aromatic compounds[4]). This was cyclo-octatetraene (IV; *see* review[5]), synthesized originally by Willstätter[6] in 1911 and much later by the polymerization of acetylene in the presence of nickel cyanide by Reppe.[7] However the physical properties of the molecule show that it is non-planar, and as another requirement for aromatic character is molecular planarity, cyclo-octatetraene need not be considered further. The properties of the double bonds are typically those of the olefinic type, and the chemistry of cyclo-octatetraene is dominated by its addition reactions.



(IV) (V) (VI)

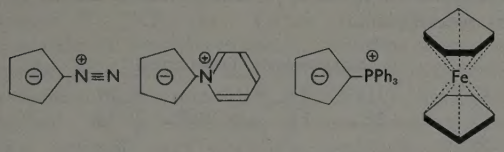
Cyclobutadiene (V), with only four π-electrons associated with the ring, has not yet been obtained in the free state in spite of numerous attempts, and clearly it is not a stable molecule possessing aromatic character. However, it should be mentioned that Longuet-Higgins and Orgel[8] predicted that the π-complex of cyclobutadiene and a nickel ion was intermediate in the preparation of cyclo-octatetraene from acetylene, and in fact a complex from tetramethylcyclobutadiene and nickel chloride (VI) has recently been prepared.[9] Nenitzescu[10] has also obtained the silver nitrate complex of cyclobutadiene itself.

However, an immense field of new chemistry was uncovered when it was realized that a five-membered ring, cyclopentadiene, could achieve the aromatic state in the form of its anion, which was originally described by Thiele.[11] The theoretical relation of this anion to benzene was recognized by Robinson[12] more than 30 years ago, and shortly afterwards by Ingold.[13] The stable derivatives (VII)[14], (VIII)[15] and (IX)[16] all contain a cation within the molecule to balance the negative charge of the cyclopentadienyl anion, but the most remarkable examples are found in the ferrocene (X) series.

Since its discovery in 1951,[17] over 200 papers (*see* reviews[18]) have appeared on the properties of this very

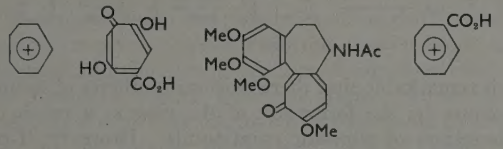
* Lecture to the East Midlands Section, 29 October, 1959.

stable molecule and its congeners, which possess many of the typical characteristics of aromatic compounds.



(VII) (VIII) (IX) (X)

The above conditions for aromatic character are also obeyed in the cycloheptatrienylium cation (XI), but compounds containing this grouping were not recognized until 1945 when Dewar[19] postulated the tropolone ring system to account for the aromatic properties of stipitatic acid (XII) and colchicine (XIII).

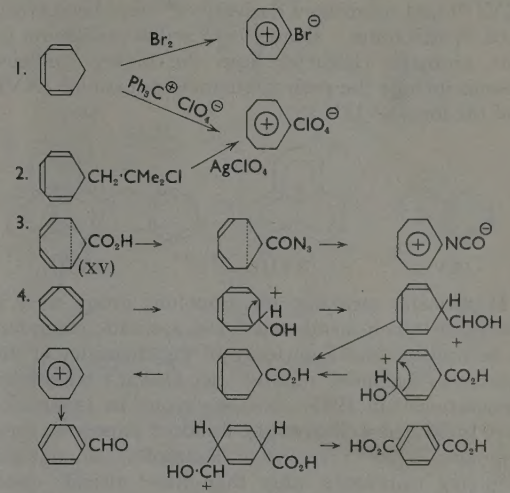


(XI) (XII) (XIII) (XIV)

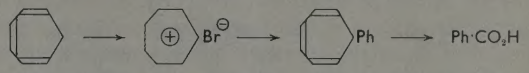
The parent compound, tropylium bromide,[20] was obtained by distillation of the dibromide of cycloheptatriene, a reaction which had been described many years before by Merling,[21] who had even mentioned the colourless water-soluble residue from the distillation! Shortly afterwards, the carboxy derivative (XIV) of tropylium bromide was obtained,[22] by a similar type of reaction, in an attempt to utilize the cycloheptatrienecarboxylic acids, derived from benzene and diazoacetic ester, as starting products for a synthesis of tropylium salts. This synthesis was accomplished by Dewar and Pettit[23] who converted the so-called norcaradienecarboxylic acid (XV) through its azide to the isocyanate of tropylium by heating in benzene. Other ingenious methods of preparation of tropylium salts include the formation of the perchlorate by the direct action of triphenylmethyl perchlorate on a solution of cycloheptatriene in acetonitrile,[24] 'fragmentation' reactions of substituted cycloheptatrienes, *e.g.* treatment of 1-cycloheptatrienyl-2-methyl-2-chloropropane with silver perchlorate in acetonitrile,[25] and the oxidation of norcaradienecarboxylic acid.[26] This last acid is probably an intermediate in the oxidation of cyclo-octatetraene to tropylium salts and terephthalic acid, and these salts, by further ring contraction, yield benzaldehyde.[27] The suggested mechanisms are shown below.

The symmetrical structure for the tropylium ion has been confirmed by spectral measurements[28] and by an ingenious chemical method[29] whereby ^{14}C-labelled cycloheptatriene was first synthesized by the reaction of labelled diazomethane with benzene. Conversion of the cycloheptatriene to tropylium bromide, and thence by a Grignard reaction to phenylcycloheptatriene and

SYNTHESIS OF TROPYLIUM SALTS

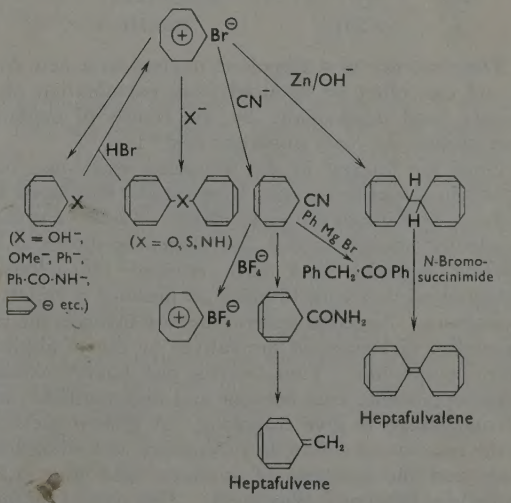


finally oxidation to benzoic acid gave a product which had only one-seventh the radioactivity of the original cycloheptatriene.



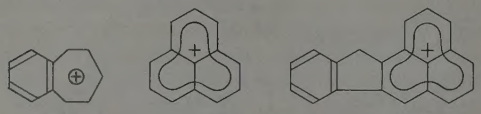
The chemical properties of tropylium salts (*see* reviews[30]) are dominated by the balance between the covalent cycloheptatrienyl derivatives and the ionic tropylium salts, the preferred structure depending on the character of the anion. The reactions may be summarized as follows.

REACTIONS OF TROPYLIUM SALTS



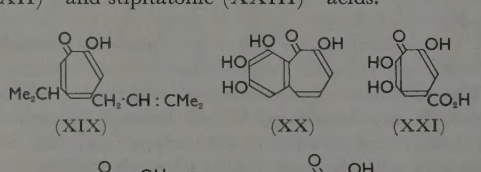
Although tropylium salts have not been obtained by the action of acids on the lithium aluminium hydride

reduction product of tropone, benztropylium salts (XVI)[31] and substituted derivatives[32] have been synthesized by this route. Examples of stable carbonium ions with aromatic character from the higher condensed systems include the perinaphthenylium cation[33] (XVII) and the ion (XVIII).[34]

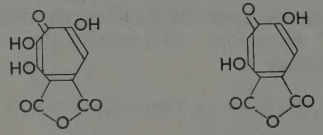


(XVI) (XVII) (XVIII)

Historically speaking, the tropolone group were the first of the seven-membered cyclic aromatic compounds to be studied, and knowledge of the chemistry of these substances expanded rapidly after Dewar's far-reaching observations[19] in 1945. Nozoe's group in Japan alone have published well over one hundred papers on simple tropolones (*see* reviews[35]). Examples of naturally occurring tropolones other than those already quoted include the α-, β- and γ-isopropyltropolones or thujaplicins, nootkatin (XIX),[36] purpurogallin (XX)[37] and the mould products puberulic (XXI), puberulonic (XXII)[38] and stipitatonic (XXIII)[39] acids.



(XIX) (XX) (XXI)

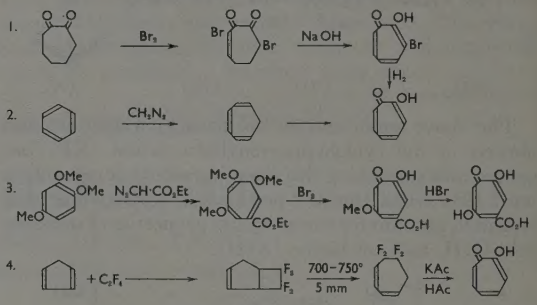


(XXII) (XXIII)

The existence of a tropolone nucleus in a new compound can often be deduced from examination of its spectra, and occasionally by the results of oxidative degradation, *e.g.* with puberulic acid[38]:

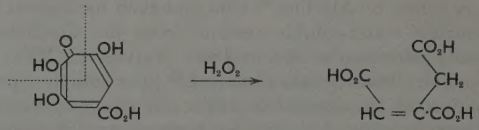
Once the interest in the tropolone series had been established, synthetic routes were rapidly developed and a choice of methods is now available. Cook[40] and independently Nozoe[41] used 1, 2-cycloheptanediones as the starting materials and have effected the necessary dehydrogenation with bromine to produce a variety of tropolones. A second general method involves the ring expansion of benzenoid derivatives by use of aliphatic diazo-compounds. Thus Doering and Knox[42] oxidized cycloheptatriene, from benzene and diazomethane, with permanganate to give tropolone. A related method[43] is the reaction of *o*-dimethoxybenzenes with diazoacetic ester and the synthesis of stipitatic acid from 1,2,4-trimethoxybenzene is illustrated. This type of synthesis of tropolones from benzenoid precursors is not followed in Nature however.[44] A more recent synthesis[45] depends on the Diels–Alder adduct (XXIV) from cyclopentadiene and tetrafluoroethylene which is pyrolysed and hydrolysed to yield tropolone in about 20 per cent overall yield.

SYNTHESIS OF TROPOLONES

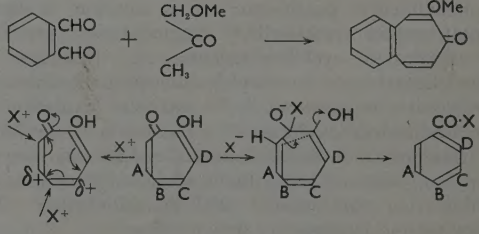


(XXIV)

It is remarkable that there exist no syntheses of simple tropolones by the formation of the ring as a result of condensation of aliphatic compounds. However, Tarbell[46] and independently Fernholz[47] have prepared βγ-benztropolone by the condensation of acetol or its ethers with phthalaldehyde but attempts to apply this synthesis to maleic dialdehyde failed.[48]

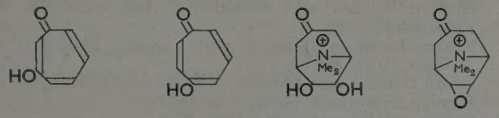


Tropolone readily undergoes a variety of electrophilic substitutions at the 3-, 5-, and 7-positions (XXV) but a special reaction, which has been widely used in determining the orientation of substituents in the tropolone ring, is the ring contraction undergone by these compounds in the presence of alkali.



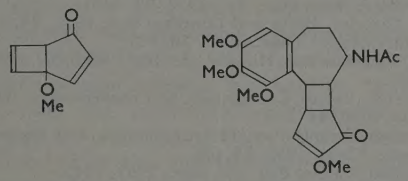
The presence of electron-attracting groups in the α- and γ-positions facilitates this rearrangement, *e.g.* 3,5-dinitro-6-isopropyltropolone forms 2,4-dinitro-5-isopropylbenzoic acid with warm aqueous alcohol.[49] On the other hand puberulic acid can be recovered largely unchanged after fusion with potassium hydroxide at 300°C, a property which was of value in its synthesis.[50]

The ring expansion of methoxybenzenes with diazoacetic ester has also been applied to the *m*- and *p*-dimethoxybenzenes, which yield the 3- (XXVI) and 4-hydroxytropones[51,52] (XXVII). Other methods for the preparation of 4-hydroxytropone, including a bromination of cycloheptanone[53] and the Hofmann degradation of teloidinone methiodide[54] (XXVIII) have been described. It is interesting to note however that a similar reaction with scopinone methiodide (XXIX) gave only *m*-hydroxybenzaldehyde.[55]



(XXVI) (XXVII) (XXVIII) (XXIX)

A comparison of the properties of the three isomers of hydroxytropone emphasizes[52] the modification of the physical and chemical properties of tropolone caused by the hydrogen-bonded hydroxyl group. An interesting reaction of 4-methoxytropone is its conversion by irradiation to the bicyclic derivative[56] (XXX), which finds a parallel in the irradiation of colchicine, as seen in the structures for the β- and γ-lumicolchicines[57] (XXXI).

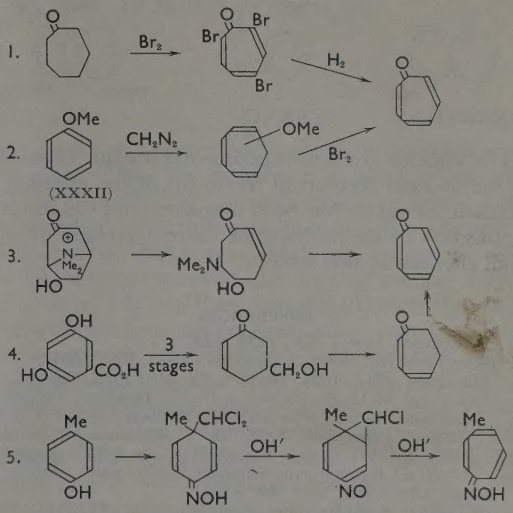


(XXX) (XXXI)

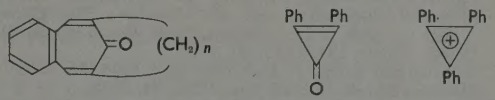
The 3- and 4-hydroxytropones are typical substituted tropones, and in the tropone series also a variety of ingenious syntheses is available. The parent compound, tropone or cycloheptatrienone (XXXII) has been prepared either from cycloheptenone,[58] or better cycloheptanone,[59] by oxidative bromination and subsequent hydrogenolysis or alternatively from anisole by ring expansion with diazomethane and subsequent oxidation by bromine.[60] Other routes include the Hofmann degradation of the quaternary salts of tropinone[61] or 6-hydroxytropinone[62] (*see* review[63]) and other methods whereby the benzene ring can be expanded to the seven-membered ring,[64] including a modification of the Reimer–Tiemann reaction.[65] This method forms the basis for a recent total synthesis of colchicine.[66]

Several syntheses of benztropones, including the ring expansion of α-tetralones[67] and the oxidation of benztropylium salts,[68] have been described. An interesting variation in the physical properties of the 4,5-benztropones (XXXIII) by changing the size of the polymethylene ring, which forces the carbonyl group out of the plane of the benzene ring, is described in a series of Swiss papers.[69]

SYNTHESES OF TROPONE

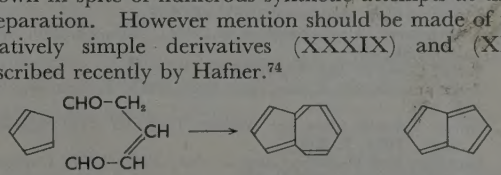


Under Hückel's general conditions for aromatic character, *i.e.* $(4n + 2)$ π-electrons in the closed ring system, all of the examples considered so far have been in the series $n = 1$, *i.e.* 6 π-electrons associated with the ring. Another possible test case is $n = 0$, and applies to the cyclopropenone ring. Examples of such compounds have been provided with 2,3-diphenylcyclopropenone[70] (XXXIV; *cf.* tropone) and the triphenylcyclopropenylium salts[71] (XXXV; *cf.* tropylium salts). Not much is known as yet of the properties of these compounds but even their existence is of considerable theoretical interest.

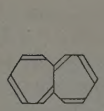


(XXXIII) (XXXIV) (XXXV)

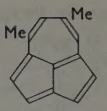
The foregoing concepts can of course also be applied to non-benzenoid bicyclic systems, the best known of which is the azulene (XXXVI) group (*see* review[72]). These compounds are frequently observed in dehydrogenation and other pyrolytic reactions but a useful preparative method is the condensation of cyclopentadiene and glutaconic dialdehyde[73] (from pyridine). Many of the typical aromatic substitution reactions are shown by the azulenes.[72] On the other hand, pentalene (XXXVII) and heptalene (XXXVIII) are still unknown in spite of numerous synthetic attempts at their preparation. However mention should be made of the relatively simple derivatives (XXXIX) and (XL), described recently by Hafner.[74]



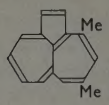
(XXXVI) (XXXVII)



(XXXVIII)



(XXXIX)



(XL)

The impetus given to experimental organic chemistry by the original theoretical treatment of the question of aromatic character has been immense, and the result is a reflection of the widespread current general interest of all chemists in this subject.

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ERRATA

The contributor of the leading article in the February issue was Sir William Ogg. We regret this was not made clear in the list of contents.

In the notice of the late Mr B. G. Fagan (*J.*, 43) it was stated that he joined the board of *Vitamins Ltd.* This should have read *Vitmin Ltd, Dublin.*

The second name of the late Mr Ferns (*J.*, 43) was *Fitzpatrick*, not *Frederick.*

In the obituary of Mr Chris Sanford (*J.*, 1959, 545) for *Toronto* read *Kingston, Ontario.*

Change of Name (*J.*, 1959, 671):—For *Marrion, Dilys*, read *Manion, Dilys Ann.*

DUST—NUISANCE AND DANGER

By P. F. Holt, ph.d., d.sc., f.r.i.c.*

Department of Chemistry, University of Reading

Almost every industry has a dust problem. The dust may merely have a nuisance value or it may damage machinery, foul electrical contacts or affect the health of workers. Some dusts produce allergy, some are systemic poisons, others produce the lung diseases known collectively as pneumoconioses, or specifically by such names as silicosis, asbestosis, talcosis and the like.

The poisonous nature of certain dusts has been known for a long time. Pliny stated that workers protected themselves by covering their faces with pig's bladders, and dusts containing arsenic caused deaths in the mines of the Middle Ages. The poisons were assumed to be placed in the mines by miniature men, or goblins, called 'kobolds.'

The most widely studied dust disease is silicosis. It is puzzling because, although silica is usually regarded as a chemically inert oxide, it can act as a catalyst in the production of scar tissue in the lung; *i.e.* it accelerates the synthesis of the protein collagen. Another lung disease is caused by the group of minerals called asbestos, the commonest member being the magnesium silicate, chrysotile. Until recently only elementary precautions were taken against asbestos dust because its dangerous nature was not appreciated. Nowadays stringent precautions are taken, particularly very efficient exhaust ventilation. The dust of beryllium has unusual effects. When inhaled it is a systemic poison, although its most obvious effect is the production of lung lesions.

Other siliceous dusts which are believed to cause pneumoconiosis are talc, kaolin and possibly mica. Much higher concentrations of these dusts are necessary to produce the level of tissue damage caused by uncombined silica. Silicon carbide dust appears to be relatively inert. Some materials which do not contain silicon may produce pneumoconiosis; aluminium is a particularly interesting and baffling case. A number of fatal cases of aluminosis caused by the inhalation of finely powdered aluminium have occurred, yet in many works aluminium powder is inhaled with no apparent ill effects. Indeed, aluminium powder has been used as an antidote to silica. Farmer's Lung, or aspergillosis, is a disease, sometimes fatal, which is caused by the inhalation of organic matter containing fungi.

Silicosis has for many years been known as a serious disease, and it is sometimes fatal. During the last century, Sheffield knife-grinders who inhaled the dust from their sandstone grinding wheels seldom lived beyond the age of 30. Inhaled silica is largely ingested by phagocytes, the scavenger cells of the body, and it is removed into the trachea from whence it is coughed up. A few particles of dust are retained by the lung, however, and around these particles collagen fibres form until large areas of lung tissues may be replaced by collagen. Both in physiological and pathological processes collagen, together with large quantities of polysaccharide, is synthesized by fibroblasts, which are specialized cells. The primary units are in the form of minute rods of the protein. It has been suggested that the polysaccharide at first prevents premature aggregation of these small rods. Much of the polysaccharide is later removed; what remains serves to align and cement together the collagen units. Several attempts have been made to explain the role of silica in the synthesis of collagen. One theory assumes that the silica particles dissolve in the cytoplasm of the cells and the resulting silicic acid hydrogen-bonds to collagen units, giving links which are not affected by enzymes, as are the bonds between carbohydrate and collagen.

The interaction of proteins in general, and collagen in particular, with silicic acid has been studied by using protein monolayers spread on substrates of silicic acid in a Langmuir trough. Polyamide films behave like protein films and so have been used as protein models. It has been demonstrated that silicic acid beneath a protein film may undergo two-dimensional polymerization, thus forming a coherent two-dimensional layer underneath the film. This occurs only at about pH 6 with most proteins, the pH at which silicic acid gels most rapidly. The properties of the protein films are altered and the films are said to be 'tanned.' Collagen is tanned by silicic acid over a very wide pH range, and it is suggested that this is due to the bridging of hydroxyproline groups in the collagen by the silicic acid. Very dilute solutions of silicic acid (even 0·0001M) may be concentrated and polymerized beneath polyamide films.

It has been suggested that the cell responds to the presence of silica by the production of collagen precursors and polysaccharides. The polysaccharides first prevent the aggregation of collagen units but they are later partly removed and may then assist in cementing them together. In normal conditions the collagen of scar tissue may, after a time, be almost completely dispersed, and it seems that there is normally an equilibrium between the processes of formation and dispersion of fibres. If silicic acid is present it may be irreversibly adsorbed by hydrogen-bonding, the collagen units being aligned and so giving permanent fibres that cannot be dispersed by tissue enzymes.

* Abstract of a Lecture to the Bristol and District Section, 15 October, 1959.

Book Reviews

CHEMISTRY OF CARBON COMPOUNDS. Volume IV, Part B. Edited by E. H. Rodd. Pp. xviii + 809-1464. *Amsterdam: Elsevier Publishing Company; London: D. Van Nostrand Company Ltd*, 1959. 100*s*.

Heterocyclic chemistry is the vast concern of volume IV of 'Rodd,' which is appearing in three parts. The second part, IV B, published last July, brings a stage nearer completion the prodigious task of presenting a comprehensive account of this immense and important field of organic chemistry. The exceptionally high standard set by the first part is admirably maintained. It is a great pleasure to state that authors, editor, advisers and publisher deserve the highest praise for presenting so complex a subject in such a detailed yet surprisingly concise form. Nothing of importance has been omitted and yet the matter is not unwieldy.

Part IV B begins with a well-balanced chapter by Dr N. Campbell on six-membered rings containing one oxygen or sulphur atom, which covers pyrans, pyrones, chromens, chromans, xanthens and isomers, and their derivatives and sulphur analogues; it also includes many natural products of the plant kingdom such as the coumarins, anthocyanin and flavone colouring matters, catechins, patulin, rotenone and the vitamins E. This is followed by an interesting account from Sir Robert Robinson of the brazilin and haematoxylin group of compounds related to the catechins, which are particularly noteworthy for the molecular rearrangements encountered in their chemistry. Compounds with two fused five- or six-membered rings each of one hetero-atom are then considered (by Dr N. Campbell) amongst which are the phenanthrolines, naphthyridines, pyrrocolines and julolidine. An excellent survey of the field of cyanine dyes is given by Dr G. de W. Anderson, followed by chapters from Dr T. S. Stevens on the indigo group, which make no mention of the β-iso-indigos, and on the pyrrole pigments. The last topic includes the bile pigments, haemoglobin and other natural porphyrin complexes, chlorophyll, synthetic porphins and chlorins, porphyrin biosynthesis, vitamin B_{12}, and the wholly synthetic but related phthalocyanines and azaporphins. Having worked in a small section of the last of these fields, I have read this chapter with particular interest. Dr Stevens has in a short space of some 50 pages covered a complicated series of subjects most interestingly and completely; his treatment of chlorophyll and of haemin could hardly be bettered within the same space. The next chapter by Drs Ishbel Campbell and T. S. Stevens is devoted to compounds with rather unusual hetero-atoms—silicon, phosphorus, arsenic, bismuth, tin, iodine and so on. This wide field is competently covered in less than 40 pages. A last chapter by Drs Ramage and Landquist describes the fundamental chemistry of the diazines and their mono- and di-benzo fused-ring counterparts. Pyridazines, cinnolines, phthalazines, pyrimidines, quinazolines, pyrazines, quinoxalines and phenazines are very adequately treated.

This Part IV B, like the previous volumes of 'Rodd,' will constantly be consulted by students, teachers, research workers and all who have interests in heterocyclic chemistry. The price may seem high, but the present volume is really extraordinarily good value. Many chemists will consider the expenditure essential because 'Rodd' is such a conveniently sized, well-written and documented reference book, most pleasingly printed, with a wealth of helpful structural formulae. But it is more than a good comprehensive reference book—it is actually readable, indeed easy and most interesting to read. This is high achievement!

J. A. ELVIDGE

SYNTHESES OF HETEROCYCLIC COMPOUNDS. Volumes 1 and 2. Edited by A. L. Mndzhoian. Translated by A. E. Stubbs. Pp. 84. *New York: Consultants Bureau Inc.; London: Chapman and Hall Ltd*, 1959. 48*s*.

This book contains the first two volumes of a series which the Institute of Fine Organic Chemistry of the Academy of Sciences of the Armenian SSR has undertaken to produce. The title of the series suggests that a more general coverage of methods suitable for the synthesis of heterocyclic compounds will occur in future publications. However, this book does suffer from the very real shortcoming of being devoted to the synthesis of furan derivatives only. An attempt is made to justify this in the preface by referring to a current interest in this topic, but it is surely doubtful whether the activity in this field is so extensive that the exclusion of other heterocyclic compounds from this first publication is really justified.

The style of the book is practically identical with that of *Organic Syntheses* which has provided an excellent service to organic chemists for almost 30 years; this publication of Russian origin is not a serious competitor. In fact a number of the preparations described in this book have already appeared in *Organic Syntheses*. In 1949, these directions were translated from English into Russian and appeared in *Organic Syntheses* (Russian Translation) which was published by the Foreign Lit. Press, Moscow. Now, ten years later, they have been translated back from Russian to English. Comparison of this English version with the original is therefore of some interest; it would appear that the quantities of reagents are identical, but the yields have in some cases been slightly increased.

This book contains directions for the preparation of 60 furan derivatives, of which 36 have already been published in various Russian journals by the Editor and his colleagues. Two of the methods described

have not been published previously. The presentation of the book is good and very few errors were detected.

The appeal of this book is bound to be limited, yet the effort which had to be made in translating it from the Russian must have been considerable. The quality of the translation is very good, but as the necessity to translate other important Russian contributions to the chemical literature certainly exists, it is felt that the effort of translating this book should have been directed elsewhere.

W. D. Ollis

APPLICATIONS OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY IN ORGANIC CHEMISTRY. L. M. Jackman. Pp. xii + 134. *London: Pergamon Press Ltd*, 1959. 35*s*.

This useful monograph, though designed specifically to give organic chemists a working knowledge of nuclear magnetic resonance spectroscopy and facilitate their use of this technique, may also be commended to the attention of those embarking on this field of investigation for its own sake.

The short theoretical section gives a physical picture, with a minimum of mathematical equations, of the various terms associated with nuclear magnetic resonance spectroscopy. The text is aided by a number of clear diagrams. Similarly, the fine structure of high resolution spectra is considered, together with the forces giving rise to various observable phenomena.

In view of the purpose of the book, description of experimental methods is wisely restricted to an outline of basic apparatus required for the production and detection of the spectra. Especially useful in this section are the concise experimental details, given with explanation, of many factors affecting the production and quality of results. Methods of calibrating spectra and of estimating the number of nuclei giving rise to the signal are recorded, together with criteria for suitable reference standards.

The basis on which tables of chemical shifts, given in Chapters 4 and 5, are compiled is stated clearly, and the effect of various adjacent atoms, groups, and hydrogen-bonding on the values of the shifts are stated and briefly discussed. The way in which certain structural features affect proton frequencies is also considered and attention drawn to possible correlations with other phenomena, such as the activation of the benzene nucleus in electrophilic substitution. Although Jackman's primary concern is with proton magnetic resonance, a welcome inclusion is a brief review of resonance frequencies of other nuclei of special interest to organic chemists.

General procedure for analysis of spectra of molecules of gradually increasing complexity is outlined and the application of proton magnetic resonance spectroscopy to conformational analysis described in the two final chapters. Specific examples, illustrating the use of the technique, add weight to the case for its increased use by organic chemists.

Unlike many such compilations, this book gives a useful indication of possible future trends. Jackman mentions some of the areas in which more data are required, and points out potential uses of the technique, such as in the detection of epoxides and in the field of organo-phosphorus chemistry.

The book contains few typographical errors, and only one particularly unpleasant phrase—'both carbon and oxygen do not possess magnetic moments.' A number of useful references are given at the end of each chapter.

C. M. French

THE GEOCHEMISTRY OF RARE AND DISPERSED CHEMICAL ELEMENTS IN SOILS. Second Edition. A. P. Vinogradov. Pp. 209. *New York: Consultants Bureau, Inc.; London: Chapman & Hall*, 1959. 80*s*.

This is a translation of the second, revised edition of Vinogradov's monograph, the first edition of which appeared in Russian in 1950 and in German translation in 1954. It presents in readily accessible form many of the results from Russian laboratories, and is therefore a welcome addition to the literature on trace elements in soils. The 22-page bibliography is particularly valuable in view of the many rather inaccessible references which it details.

The findings are generally in line with those of other workers, although it was at first sight surprising to find comparisons made on the basis of zonal soil type rather than geochemical character. The soils of the Great Russian Plain are, however, derived from relatively uniform sedimentary parent material; nearer the mountains and on igneous rocks greater variations in the contents of trace elements occur in the parent materials.

In the 19 chapters some 50 elements are discussed at lengths varying from a few lines to some 15 pages. Emphasis throughout is on total rather than soluble or available content. Unfortunately, the mode of presentation of the results is rather unsatisfactory. Percentages, rather than parts per million, are given rather indiscriminately as, for instance, 0·005 per cent, or $0{\cdot}5 \times 10^{-2}$ per cent or 5×10^{-3} per cent, the last form being most frequently employed. Different modes of presentation of the same content occur in successive lines. The necessity of interpreting both coefficient and exponent in each content makes quick comparison within tables rather difficult, and the system is very susceptible to misprinting. There are many obvious errors, apparent from internal evidence, which should have been observed in the course of translation or proof-reading. Some of these occur also in the German translation of the first edition, and must be in the original. Inaccuracies occur also in the rendering of technical terms—one soil, a loam in the original

reference, now appears as a clay on p. 132—and they are often, as in the title, somewhat stilted.

Despite these minor defects, readily detected by the careful reader, this is a most valuable book, giving probably the first comprehensive description of the trace-element status of the soils of an extensive region, together with a selective review of the world literature.

R. L. MITCHELL

A DIGEST OF ELEMENTARY CHEMICAL THERMODYNAMICS. D. Shireby. Pp. xi + 140. *London: Sir Isaac Pitman & Sons Ltd*, 1959. 20*s*.

This is a plain and orthodox introduction to the essentials of chemical thermodynamics and is aimed at first-year undergraduates. It is written in an even style and avoids all subtleties. Each of the derived relations is illustrated with well-chosen examples and there is a large number (72) of first-rate problems, with answers, covering the first, second and third laws.

The book keeps strictly to the limits implied in its title. Although chemical equilibria and several aspects of electrochemistry are included in the text, there is no generalized treatment of thermodynamic functions and its consideration of entropy is sparse. There are several *non-sequiturs*, occasioned perhaps by the length of the book, and these may bother the brighter student. The single criticism of the book is that its self-set limits are not more frequently stated, for not-so-bright students might smugly believe that knowing all this they understand at least the first three laws of thermodynamics. Even this might be argued in its favour, if it remedies the defeatism with which the subject is often met.

As a stepping stone to a more complete understanding of the subject, this book serves its purpose well, although the list of books for further reading is unselective and unsatisfactory. It is written in plain prose with the average student continually in mind, and with the author clearly on his side. There are a few minor errors (*e.g.* data for datum) but otherwise it is well presented in clear and attractive type. All the information contained in the text can be found elsewhere but, nevertheless, taken together with the exercises and problems, it makes a valuable teaching book which all intending graduates should read and assimilate.

G. J. HILLS

CHEMICAL PROCESS PRINCIPLES. PART II. THERMODYNAMICS. Second Edition. By O. A. Hougen, K. M. Watson and R. A. Ragatz. Pp. 567 + lvi. *New York: John Wiley & Sons, Inc.; London: Chapman & Hall Ltd.*, 1959. 78*s*.

The second edition of this well-known book has an additional author and 200 more pages than the first. It is certainly a much-improved volume, although the first chapter, on thermodynamic principles, still leaves something to be desired as a systematic treatment of the basis of thermodynamics.

One of the features of the original 'Hougen and Watson' which chemical engineers had found most useful was the extensive set of graphs showing the fugacity, the enthalpy departure, heat capacity and so on, of imperfect gases as functions of the reduced temperature and pressure, as based on the theory of corresponding states. These studies have recently been extended and the authors have been led to use a third correlating parameter, which they choose as the value of the compressibility factor at the critical point. The results are presented in the second chapter.

The original third chapter, on expansion and compression of fluids, has undergone fission and cascaded into five new chapters, covering vapour power plants, internal combustion engines, liquefaction of gases and refrigeration. Much of the contents of these chapters is closer to mechanical engineering thermodynamics than to chemical or to chemical engineering thermodynamics. Yet I would agree that it would be desirable for our chemical engineering students to have a grasp of these branches of applied thermodynamics—if they had the time !

The fourth and fifth chapters of the original have also been expanded and have been replaced by four chapters on phase equilibria and the properties of solutions. This part of the book has been immensely improved—yet oddly enough I can find no proof of the phase rule; and Gibbs's name, too, is missing from the index.

The material of the two final chapters of the original version on chemical reaction equilibrium has been rearranged and appears now as three chapters. Relatively little new has been added and the short account of statistical mechanics has been left out. An important section in one of these chapters is concerned with the empirical 'group contributions' to the thermodynamic properties of substances. Many chemists and chemical engineers had found these extremely useful in cases where these properties have to be estimated.

K. G. DENBIGH

TASCHENBUCH FUR DIE WACHSINDUSTRIE. Edited by C. Ludecke and L. Ivanovszky. Pp. 718. *Stuttgart: Wissenschaftliche Verlagsgesellschaft m.b.H.*, 1958. DM.48.

This is the fourth edition of a pocket book dealing with the properties and industrial application of waxes; it attempts to summarize all information available or likely to be useful to those concerned with wax technology. The work is divided into nine parts.

Part I covers history, definitions and classification. The term wax can no longer be limited to those substances which consist mainly of esters, and hence waxes can no longer be adequately covered in textbooks

devoted mainly to fats. The authors suggest (p. 30) that 'wax is the collective technical term for a range of substances produced either naturally or artificially and which usually have the following properties:—solid plastics to brittle hard solids at 20°C, coarsely to finely crystalline, translucent to opaque (yet not glass-like), melting without ropiness or decomposition above 40°C, consistency and solubility very dependent on temperature and capable of being polished under light pressure.' It might be questioned whether this is a satisfactory definition but at least it is an indication of the range of substances treated in this volume.

Part 2 deals with the natural waxes, including animal waxes, fossil waxes, plant waxes and tallows. Beeswax occupies some 17 pages in which its sources, purification and properties are described. Sugar-cane wax, which has recently received attention in most sugar-growing areas, has as yet only been developed in America. Some of the dangers which attend the examination of material available commercially are indicated in a recent note by J. A. Lamberton and A. H. Redcliffe (*Chem. & Ind.*, 1959, 1627). They report that the cuticle wax of sugar cane consists mainly of long-chain aldehydes and that many of the compounds which occur in the commercial wax are artefacts. The possibility that constants recorded in the literature do not represent the material as it occurs naturally must be borne in mind; variations from recorded figures do not necessarily indicate adulteration. Apart from a description of the various mineral waxes (Part 3) there is also a discussion of methods suitable for refining them.

Part 4 covers synthetic and chemically modified waxes, whereas Part 5 lists the commercial types, the properties and the methods of evaluation of waxes. It also provides references to standard methods for testing and there is a small section devoted to statistics, including tables showing a quantitative breakdown of usage.

The remainder of the book (p. 402 onwards) deals with supplementary raw materials, such as fats and colours (Part 6), the applications of waxes (Part 7), and analytical methods (Part 8). Most of the common physical and chemical methods used in investigational work are described but some of the more specialized techniques (*e.g.* Kaufmann's work on paper chromatography) are covered by references. Finally, Part 9 is a collection of 23 useful tables listing factors for solutions, properties of fatty acids, temperature conversion data and the like.

There are few recent textbooks which cover the field surveyed by the present work. Its appearance can therefore be welcomed and it can be recommended to all those concerned with any aspect of wax technology. A wealth of information has been cunningly compressed so as to fit into a somewhat bulging pocket but with its aid most technical problems involving waxes, whether animal, vegetable or mineral, should be capable of solution.

W. D. RAYMOND

HANDBOOK OF ELECTROCHEMICAL CONSTANTS. R. Parsons. Pp. viii + 110. *London: Butterworths Scientific Publications; New York: Academic Press Inc.*, 1959. 30*s*.

This volume is designed as a general reference book of electrochemical data in 13 sections: fundamental constants and properties of ions, salts, and solvents; values of theoretical electrochemical functions; activity coefficients; thermodynamic properties of sodium hydroxide and hydrochloric acid solutions; thermal properties of electrolytes; equilibrium constants; molal volumes of electrolytes; molten salts; equilibrium properties of electrodes; viscosity and diffusion in electrolytes; conductivity; kinetic properties of electrodes; and surface tension, dielectric constant, and refractivity data. Some of the information is highly specialized; it is unlikely, for example, that many chemists will often need to look up the surface tension of dilute solutions of caesium iodide. Much of it, however, such as activity coefficients, redox potentials, solubility products and dissociation constants, is very frequently used, and a collection in a small volume is therefore valuable.

It is most unfortunate that the sources of the data are seldom disclosed. This applies with especial force to tables of derived data, such as the lattice energies of salts and the solvation energies of ions, in the complilation of which several sources, of various ages and reliabilities, appear to have been collated. Any subsequent edition should certainly disclose the author and date of information, if only so that the user may verify details of methods of measurement and check that nothing new has become available since these tables were compiled.

A. G. SHARPE

GENERAL CERTIFICATE CHEMISTRY (Ordinary Level). L. H. Angus. Pp. viii + 509. *London: University Tutorial Press Ltd*, 1959. 13*s*. 6*d*.

The book is designed to cover the last two or three years of the Ordinary Level Course. The arrangement is the familiar one in which an introduction to chemical change and nomenclature is followed by chapters dealing with quantitative work and the laws and theories of chemistry, including the structure of the atom and of molecules. Chapters on the experimental study of the elements and their compounds follow.

Special features of the book are the clarity with which the theoretical work is explained, and the emphasis on chemical principles throughout. One recognizes the work of a thoroughly good teacher with a wide experience of teaching at this level and beyond. Calculations are well set out and fully explained. Great care is exercised in the definition and use of terms which will be extended in more advanced work.

The three theories of electrolysis are explained in full and it is left for the teacher to select from the secondary

reaction theory, selective ionic discharge and the water molecule discharge theory. Oxidation and reduction reactions are carefully discussed in the chapter on oxygen, and further examples are clearly set out and emphasized in the rest of the text. A reference to the electronic theory of oxidation and reduction appears in the section on structures of atoms and molecules. The book is very well supplied with cross references.

Experiments related to the subject-matter are collected at the end of each chapter and are well chosen to illustrate basic principles; many are new and simple modifications of well-known experiments which will be welcomed by teachers. Questions at the end of each chapter are closely related to the text and are carefully graded to assist in the intelligent use of the book. Questions or paragraphs marked with an asterisk deal with more difficult matter, and the limited use of this device adds to the value of the book for the abler pupil.

Diagrams, though clear and well labelled, suffer from questionable simplifications such as corks which would defy attempts at removal from the necks of flasks. Several good plates of industrial processes are given.

D. M. KETT

ELECTROLYTIC MANUFACTURE OF CHEMICALS FROM SALT. D. W. F. Hardie. Pp.xii + 74. 7*s*. 6*d*. AMMONIA: MANUFACTURE AND USES. A. J. Harding. Pp. xiii + 41. 6*s*. 6*d*. *London*: *Oxford University Press, published under the auspices of I.C.I. Ltd*, 1959.

These two volumes form part of a series of textbooks sponsored by Imperial Chemical Industries Ltd. They follow the high standard set by the monograph on sulphuric acid, published in 1955, and are authoritative, well-written accounts of two important branches of chemical industry.

An adequate description of the first is given by the chapter headings: fundamental aspects of brine and salt electrolysis; raw materials and energy; the manufacturing processes; packing, storage and transport of the products; production statistics and trends; physical and chemical properties of the products; principal uses of the products; outline of historical development. The account is systematic, concise and related to theoretical ideas. It is unfortunate that in a book of such excellence there are one or two unconventional usages, as for example in the formula of sodium zincate on page 50.

The second book, *Ammonia*: *Manufacture and Uses*, has been equally well prepared, and again great care has been taken to relate basic principles to the problems described. The author points out that the various processes formerly used in the manufacture of synthetic ammonia have gradually evolved into a single process with minor variations. The account contains much valuable discussion on the sources of raw materials used and on the various developments of the last 20 years. A useful feature, rarely seen in textbooks, is the reference to the several methods available for the removal of carbon dioxide from the exit gases of water-gas shift converters.

Both books have an appendix listing terms and laws mentioned in the text, and a bibliography to assist those who wish to deal more fully with the subject matter. They are well produced and contain very few printing errors. Colleges and schools will find them extremely valuable, especially if they are used to supplement established textbooks. It is hoped that other monographs in this series will be available in the near future.

B. E. DAWSON

ATOMIC AGE PHYSICS. (Everyman's Easy Guide to Atomics and Nucleonics.) H. Semat and H. E. White. Pp. vii + 230. *New York*: *Rinehart & Co. Inc.*; *London*: *Chapman & Hall Ltd*, 1959. 16*s*.

This is an unusual book. It originated in an unusual way and criticism of it must be framed with this knowledge in mind. It was written to cover a television course given in 1958 in the U.S.A. on atomic physics. The course appears to have been very successful and many colleges used it as a 'credit' course for students. It also provided the ordinary viewer with a record of what was undoubtedly a popular series of lectures.

The authors claim it to be a 'thorough easy-reading handbook' and 'a solid course of instruction.' Since the book is the outcome of an endeavour to spread modern physical knowledge as broadly as possible it is inevitably factual and the treatment is dogmatic. However, the presentation is a model of clarity and every chapter is well illustrated with good diagrams. An amazingly broad field of work is covered in 216 pages dealing with atomic structure, electronics, mass and energy, spectra, X-rays, nucleonics, radioactivity, nuclear reactions, fission and fusion. Practically no mathematical knowledge other than the simplest algebra is assumed.

This book could be recommended to chemistry and physics students in their earlier years of study to give a survey of modern developments which may later be studied in fuller detail. It could also be useful to those whose formal studies ended some years ago and who want an easily understood account of modern atomic physics. The book is well printed on good paper and is bound in a stout paper cover; at 16*s*. it is very good value.

A. J. LINDSEY

PUBLICATIONS RECEIVED

INTRODUCTION TO QUANTUM FIELD THEORY. F. Mandl. Pp. vii + 202. *New York: Interscience Publishers Inc; London: Interscience Publishers Ltd*, 1959. 34*s*.

HYDRAULIC RESEARCH IN THE UNITED STATES. Misc. Pub. 227. Pp. viii + 188. *Washington: Nat. Bureau of Standards*, 1959. $1.25.

Institute Affairs

EXAMINATIONS, JUNE 1960

Graduate Membership, Part I

An Examination for Graduate Membership, Part I, will be held **on Monday and Tuesday, 20 and 21 June, 1960,** in London, and elsewhere at the discretion of the Council. Candidates will be asked to state their preference as to the centre for their examination, but it must be clearly understood that no guarantee can be given that their wishes will be met.

Candidates who have not yet been accepted and who wish to present themselves in June should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time for obtaining the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Form must reach the Institute not later than Wednesday, 13 April.** No application in respect of the June examination will be accepted if received after that date.

Entry forms will be sent as soon as they are ready to accepted candidates. **The last date for the return of Entry Forms will be Monday, 9 May, 1960.** No entry will be accepted if received after that date.

EXAMINATIONS, JANUARY, 1960

Graduate Membership, Part I

Examiners: Dr C. C. Addison, Dr D. J. G. Ives, Dr F. G. Mann

The examination was held at the University of London, and at various local centres in the period 4-5 January, 1960.

The total number of candidates was 223, of whom 86 passed (38·6 per cent).

Of the 223 candidates, 20 had taken full-time courses, of whom 5 passed (25·0 per cent); 146 had taken part-time courses, of whom 55 passed (37·7 per cent); 34 had taken 'sandwich' courses, of whom 17 passed (50·0 per cent); 23 had taken part-time courses preceded by or followed by a period of full-time study, of whom 9 passed (39·1 per cent).

Graduate Membership, Part II

Examiners: Professor C. W. Davies, Professor W. G. Overend, Dr A. G. Sharpe

Assistant Examiners: Mr E. A. W. Hebdon, Dr A. D. Mitchell

The examination was held at the University of London, the theoretical papers being taken also at various local centres in the periods 4-9 January and 12-15 January, 1960.

The total number of candidates was 107, of whom 32 passed (33·4 per cent).

Of the 107 candidates taking Part II, 3 undertook their training by full-time courses (no passes), 1 attended a 'sandwich' course (passed), 33 attended part-time courses preceded or followed by a period of full-time or 'sandwich' study (14 passed; 42·4 per cent), 70 trained wholly by means of part-time courses (17 passed; 24·3 per cent).

Of the 107 candidates, 14 had previously passed Part I (9 passed Part II), and 12 had been exempted from it under the provisions of Regulation F3 (4 passed Part II).

Pass List: Part II

Boniface, Lionel Ernest George, Technical College, Coventry

Brown, Joseph Foster Charlton, Rutherford College of Technology, Newcastle upon Tyne

Bullough, Kenneth Richard, Lancaster and Morecambe College of Further Education, Lancaster

Carden, Reginald Thomas, Lancaster and Morecambe College of Further Education, Lancaster

Clark, Alexander James, College of Further Education, Slough; Northern Polytechnic, London

Crooks, Walter, Wigan and District Mining and Technical College, Wigan

Dewar, James Hilton, Rutherford College of Technology, Newcastle upon Tyne

Druce, Thomas Gordon, Lancaster and Morecambe College of Further Education, Lancaster

Fairhurst, Ronald, Rutherford College of Technology, Newcastle upon Tyne

Green, Jack Raymond, A.M.C.T., College of Science and Technology, Manchester; Stockport College for Further Education, Stockport

Hildon, Anthony Macdonald, Northern Polytechnic, London; College of Technology, Luton

Jones, Alan David, Technical College, St Helens

Kane, Joseph Richard, Constantine Technical College, Middlesbrough

Kenyon, John Henry, Lancaster and Morecambe College of Further Education, Lancaster

Leonard, Derek, College of Further Education, Widnes

McGhee, Brian, Rutherford College of Technology, Newcastle upon Tyne

Morris, Anthony, Rutherford College of Technology, Newcastle upon Tyne

Moss, Ronald, Central College of Further Education, Carlett Park, Eastham (Wirral)

Nixon, Leslie Arthur, College of Technology, Rotherham

Pugh, Miss Gladys Yvonne, Technical College, Birkenhead

Raeburn, Eric, Rutherford College of Technology, Newcastle upon Tyne

RAPER, Eric Salvin, Rutherford College of Technology, Newcastle upon Tyne

RENNISON, Peter Arthur, College of Technology, Loughborough; Municipal College, Burnley

ROBERTS, Brian, College of Technology, Huddersfield

ROBERTS, Charles Waid, College of Technology, Liverpool

SHELTON, Alan, Flintshire Technical College, Connah's Quay; Central College of Further Education, Carlett Park, Eastham (Wirral)

TAYLOR, Malcolm Stuart, College of Technology, Sheffield

THORP, Donald, College of Technology, Huddersfield

TURNER, Brian, Stockport College for Further Education, Stockport

WARWICKER, Laurence Albert, Northern Polytechnic, London

WEBSTER, Norman William Fletcher, Lancaster and Morecambe College of Further Education, Lancaster; Harris College, Preston; Royal Technical College, Salford

WILLIAMS, Brian, Technical College, Birkenhead

Institute Representatives.—The following additions and changes have been made to the list of members representing the Institute on committees concerned with technical education:

East Ham Technical College: Science Advisory Committee, Dr H. G. Rains, *Fellow*, and Mr B. White, *Fellow*.

Stockport College for Further Education: Science Advisory Committee, Dr A. F. Daglish, *Associate*.

Southern Regional Council for Further Education: Science Advisory Committee, Mr T. F. McCombie, *Associate* (in succession to Mr N. G. Thomas).

Reports of Joint Annual Meetings, Belfast.—As three articles on Belfast, entitled The City of Belfast and Industrial Ulster (Dr R. J. Magee), The Queen's University of Belfast (Mr J. C. Beckett) and The Development of the Department of Chemistry in the Queen's University of Belfast (Professor C. L. Wilson), have appeared in the February issue of *Proceedings of the Chemical Society* no preliminary articles will be published by the Institute. The Presidential Address by Mr E. Le Q. Herbert will be published in the April *Journal*, and an account of the meetings, together with the Report of the 42nd Conference of Hon. Secretaries of Local Sections, in May.

THE INTERESTS OF HIGHER NATIONAL CERTIFICATE HOLDERS

At a meeting consisting largely of representatives of technical colleges, held at Crewe on 17 October last, under the auspices of the British Association of Chemists, discussion took place on what might be done to look after the interests of those who obtained a Higher National Certificate in Chemistry but did not proceed, or succeed in obtaining admission, to graduate membership and thence to corporate membership of the Institute. Opinions were divided on the desirability of attempting to set up a new body for this purpose, and a substantial majority of technical college representatives indicated that they would prefer to see something done by the Institute, particularly through the establishment of a third 'permanent' grade of membership open to those who did appreciably more than satisfy the minimum requirements for the award of the H.N.C.

Various aspects of this question have been considered from time to time over many years, and as recently as 1956-57 (*J.*, 1957, 456). The Council recognizes however that conditions have changed notably, even in the past few years, and has been reviewing the whole position again, having regard not only to opinions expressed at meetings and conferences but also to available information on current trends in the development of education and training for qualifications in chemistry and applied chemistry at all levels. In carrying out this review the Council, with the aid of its Professional Status Committee and the Study Group on Qualifications, has naturally been in touch with the Ministry of Education who are jointly responsible with the Institute for the administration and development of National Certificates and Diplomas in Chemistry and Applied Chemistry in England and Wales.

As a result of these discussions and consultations, the Council has agreed in principle on the kinds of provisions that could be made to enable the Institute to look after the general interests of H.N.C. holders as such and to cater particularly for the needs of those with substantially higher and more broadly based attainments. After its March meeting the Council expects to be in a position to issue a statement on the main features of these provisions and on the questions that their introduction would raise. Before any further steps are taken, full opportunity will be given for discussion of relevant issues at forthcoming Conferences of Section Secretaries and of Liaison Officers, as well as at Section meetings.

PERSONAL NOTES

News of Hon Fellow

Sir John Cockcroft, O.M., K.C.B., C.B.E., F.R.S., will receive the honorary degree of D.Eng. of the University of Sheffield on 4 May. Sir John recently received a grant from the Rockefeller Foundation to attend the federal science congress in Salisbury, Southern Rhodesia (*see* p. 112).

Honours and Awards

Dr T. P. Hoar, *Fellow*, has been admitted to the degree of Sc.D. in the University of Cambridge.

Dr J. E. Lovelock, *Associate*, of the National Institute of Medical Research, has been awarded the degree of D.Sc. of the University of London for his work in the field of biophysics on the effects of low temperatures on

living cells and on highly sensitive gaseous ionization methods for chemical analysis.

Professor Sir Alexander Todd, F.R.S., *Fellow*, will receive the honorary degree of doctor of science, University of Exeter, on 4 May and that of the University of Leicester on 15 July.

Societies and Institutions

Dr H. M. Irving, *Fellow*, Vice-Principal of St Edmunds Hall, Oxford, attended the 14th Annual Convention of the South African Chemical Institute as guest of honour, and is now visiting and lecturing at universities and research institutions in South Africa.

Mr Clifford Paine, *Fellow*, *Vice-President*, gave the Sir William Jackson Pope Memorial Lecture on 'Modern Dyes' to the Royal Society of Arts on 3 February, with Sir Charles Dodds, M.V.O., F.R.S., *Fellow*, in the Chair.

Dr James Taylor, M.B.E., *Fellow*, has been elected to Honorary Membership of the Institution of Mining Engineers. There are, at present, only eight other honorary members.

Educational

Dr G. K. Gollakota, *Fellow*, has been chosen as director of the School of Basic Science and Humanities, U.P. Agricultural University, Nainital, India.

Mr C. W. Hyde, *Fellow*, has been appointed head of the department of chemistry and biology, The Polytechnic, Regent Street.

Dr K. A. Kerridge, *Associate*, has recently taken up a postdoctoral research fellowship in pharmaceutical chemistry in the School of Pharmacy, University of Maryland, U.S.A.

Dr H. Lehmann, *Fellow*, senior lecturer in chemical pathology at St Bartholomew's Hospital Medical College, has been appointed Reader.

Dr T. C. Owen, *Associate*, has left this country for the U.S.A. where he will take up a research fellowship at Vanderbilt University, Nashville, Tennessee, for one year. On his return he will take up his former post at the College of Technology, Liverpool.

Dr T. M. Oza, *Fellow*, has been appointed Professor of inorganic chemistry and head of the department of chemistry, Gujarat College, Ahmedabad, India.

Dr J. C. Parkinson, *Fellow*, head of the school of pharmacy, Brighton Technical College, is among the first six chosen under the English-Speaking Union's plan for exchanging technical college teachers with the U.S.A. He will spend eight weeks in America.

Dr R. A. Robinson, O.B.E., *Fellow*, has resigned from the University of Malaya and accepted an appointment as Reader in chemistry at the University of New England, Armidale, Australia.

Dr F. A. Rose, *Associate*, has left the University of Manchester to take up an appointment in the department of biochemistry, Physiology Institute, University College of South Wales and Monmouthshire.

Dr J. H. Skellon, *Fellow*, head of the chemistry department, Brunel College of Technology, has also been chosen for an award under the English-Speaking Union's plan (*see* Dr J. C. Parkinson above).

Mr W. J. R. Way, *Associate*, has taken up the post of senior lecturer in analytical chemistry at the Constantine Technical College, Middlesbrough.

Mr D. G. Wibberley, *Associate*, has been appointed senior lecturer to direct research in the pharmacy department of Sunderland Technical College.

Professor A. E. Wilder Smith, *Fellow*, has accepted an invitation from the University of Bergen, Norway, to be Visiting Professor of Pharmacology for the academic year 1960. He will be on leave from the University of Geneva and will lecture on chemotherapy.

Academic Visitors to the United Kingdom.—The following members of staff of overseas universities are at present in the U.K. or are expected shortly: Professor E. J. Conway, *Fellow* (University College, Dublin; 4-8 April); Dr R. F. Naylor, *Fellow*, Dr E. Pawson, *Fellow*, and Mr W. J. Peal, *Associate* (Makerere U.C.); Dr D. Vir, *Associate* (Panjab University); Professor L. J. Haynes, *Fellow* (W. Indies U.C.); Professor D. O. Jordan, *Fellow* (University of Adelaide); and Professor P. R. McMahon, *Associate* (University of New South Wales).

Consultants

Mr A. Herzka, *Associate*, principal of Pressurized Packaging Consultants Ltd (*J.*, 25) is now at Ashbourne House, Alberon Gardens, London, N.W.1 (Tel: SPEedwell 9667).

Mr M. E. Hogg, *Associate*, formerly technical manager of the chemicals department, Gollin & Co. Ltd, Melbourne, has established a practice as a plastics consultant and distributor of plastics raw materials and equipment at 462 St Kilda Road, Melbourne.

Mr R. Harold Morgan, *Fellow*, analytical and consulting chemist, has removed his laboratory and consulting room to 1 Harewood Row, London, N.W.1 (Tel: PADdington 8996).

Public and Industrial

Mr G. J. Austin, *Associate*, has relinquished his post with Garton & Sons Ltd on his appointment as chief chemist to George Payne & Co. Ltd.

Dr A. H. Cook, F.R.S., *Fellow*, director of the Brewing Industry Research Foundation, has recently joined the Board of the Arthur D. Little Research Institute.

Mr C. D. Cook, *Fellow*, research and development manager of Hickson's Timber Impregnation Co. (G.B.) Ltd, has resigned from his recent appointment as a director.

Mr W. G. Daroux, *Associate*, director of Group Developments Ltd, has been appointed to the Board of Pinchin Johnson and Associates.

Mr G. I. Early, *Associate*, has been appointed divisional chief chemist with the Central Electricity Generating Board, East Midlands Division.

Mr P. H. Havranek, *Associate*, of the Vereeniging Brick & Tile Company Ltd, Transvaal, has been appointed technical sales engineer.

Mr A. K. Hobbs, *Fellow*, has been appointed general manager of Sigma Company Limited, Melbourne.

Mr M. W. Holloway, *Fellow*, has moved to Winchester and taken up an appointment as a principal scientific

officer in the Atomic Weapons Research Establishment, Aldermaston.

Mr S. Kellett, *Fellow*, of the South Yorkshire Chemical Works Ltd, Rotherham, has been appointed director and general manager.

Mr D. B. Kernahan, *Associate*, has left this country for India where he will take up an appointment as superintendent of the blackpowder and safety fuse plants of Indian Explosives Ltd at Bihar.

Sir Patrick Linstead, C.B.E., F.R.S., *Meldola Medallist, Fellow*, has been appointed chairman of the Science Advisory Committee of the British Council and a member of the Executive Committee of the Council in succession to the late Sir Alfred Egerton.

Mr R. G. Mason, *Associate*, general works manager of A. Boake, Roberts and Co. Ltd, has been appointed a director. He has been with the Company since 1938.

Mr L. M. Miall, *Fellow*, has been appointed head of production development with Pfizer Ltd at Sandwich. Mr Miall was formerly chief chemist, Kemball, Bishop & Co. Ltd, and his new appointment is therefore within the Pfizer organization.

Mr P. G. Midgeley, *Associate*, has left the Wool Industries Research Association and taken up the post of senior textile chemist with Woolcombers Limited, Bradford.

Professor A. R. Natarajan, *Fellow*, in addition to his other posts has been appointed director of the State Forensic Science Laboratory, Madras.

Mr M. W. Perrin, C.B.E., *Fellow*, chairman of the Wellcome Foundation Ltd, had joined the Board of the Arthur D. Little Research Institute.

Mr H. A. D. Perry, *Associate*, development director of Imperial Chemical Industries Ltd, Paints Division, has been appointed a joint managing director.

Mr N. Pitchandi, *Associate*, has been appointed additional director, State Forensic Science Laboratory, Madras, and additional chemical examiner to the Government of India.

Mr C. J. Smith, *Associate*, has resigned his appointment with Dorr-Oliver Co. Ltd, and has joined Eimco (Great Britain) Limited as deputy manager, filter division.

Mr D. H. Smith, *Fellow*, has relinquished his post with Seprod Ltd, Kingston, Jamaica, and returned to this country.

Sir Walter Worboys, *Fellow*, has been elected to the Board of BTR Industries and appointed a deputy chairman. He has also been appointed a director of Associated Portland Cement Manufacturers Ltd, British Portland Cement Manufacturers Ltd and the Forestal, Land, Timber and Railways Co. Ltd.

Retirements

Mr J. D. Barr, *Associate*, retired from his post as joint managing director, Imperial Chemical Industries Ltd, Paints Division, at the end of February on medical advice.

Mr F. M. Biffen, *Fellow*, has retired from his position with the Johns-Manville Corporation, New Jersey.

Mr E. H. Nurse, C.B.E., *Fellow*, who has been acting Government Chemist since the death of Dr G. M. Bennett, will retire on 31 March.

Section Activities

BIRMINGHAM AND MIDLANDS

Chairman's Insignia of Office. The new badge, reproduced here, is entirely hand wrought in silver, part gilt and part oxidised.

The centre of interest is a finely carved low relief adaptation of the sculptured figure of Priestley. This feature is surrounded by an oval form incorporating the full title of the Institute engraved in roman capitals. This in turn is framed within the hexagonal symbol of a benzene ring.

The badge is hung below two separate links, one having the name of the Local Section, and the other the word 'Chairman,' and is suspended from a ribbon of mauve colour, mauve being the first synthetic dye to be produced commercially.

The work was designed and supervised by Cyril J. Shiner, M.S.I.A., R.B.S.A., of West Heath, Birmingham, who is well known for his considerable experience of special presentation silver and insignia work. The badge was made by London craftsmen, and represents the highest standard of craftsmanship available in this country.

Hydrogen Bonding and Some Crystal Structures. On 19 January Dr J. C. Speakman lectured on 'Hydrogen Bonding and Some Crystal Structures.' The Chairman, Mr E. G. K. Pritchett, was in the Chair, and the vote of thanks was proposed by Dr P. A. Ongley.

Dr Speakman said that the anomalous properties of water and other hydroxylic compounds have long been attributed to molecular association via the hydroxyl group. (Like effects are seen in compounds containing the NH_2 group and in FH; but discussion here is restricted to the OH group.) That the hydrogen atom played a vital role in such associations, by behaving as if it were bivalent, was perhaps first explicitly suggested by Werner about 1908, and by several others a little later. A 'mechanism' for such bivalency could not be

expected until an electronic theory of valency had been established. Latimer and Rodebush first wrote an electronic formulation, which Sidgwick (1927) generalized as coordinative: X—H←Y. Taken literally, this formulation contravenes the Pauli principle, and during the 'thirties two other explanations of what came to be called the hydrogen bond were current: (1) resonance ($X—H : Y \leftrightarrows X : H—Y$) and (2) electrostatic ($\overset{\delta-}{X} — \overset{\delta+}{H}\ \overset{\delta-}{Y}$).

In order to discuss the merits of such explanations, metrical data on hydrogen-bonded systems were needed; and at about that time physical methods for studying molecular structure began to be effective. Here attention will be mainly confined to crystal diffraction methods, since these are the most generally useful, though others may well be more important in particular cases.

When the atoms of an OH group and another O atom are roughly collinear, the minimum (van der Waals) O . . . O distance should be $\sim 3{\cdot}3$ Å. Distances less than this, in the range 3·0–2·5 Å, are often found in crystals, and are then attributed to hydrogen bonding. Hydrogen atoms are not readily located by X-ray diffraction—and least of all when they are attached to the very electronegative O atom—but the spatial disposition of the O atoms is significant, for it is almost always such as would allow the proton to be near the O . . . O line. In crystals, hydroxylic molecules always arrange themselves so as to achieve a maximum formation of hydrogen bonds. A special case of this principle occurs in the helical structures, postulated by Corey and Pauling in 1951, for the α-forms of proteins, and now probably verified in a recent X-ray analysis.

In a long hydrogen bond (O . . . O $\sim 3{\cdot}0$ Å), the proton will surely be much closer to its own O atom (substantially at its normal O–H distance of $\sim 0{\cdot}95$ Å) than to the other: O–H $\ll$ H . . . O. But, as O . . . O diminishes, O–H will tend to increase and H . . . O to decrease, until—should the process go far enough—the proton comes to be centrally placed. The estimate has been hazarded that this might happen when O . . . O became as short as 2·45 Å. In such a symmetrical hydrogen bond, at any rate, the resonance contribution should be considerable.

Experimentally the most fruitful method for definitely locating protons in hydrogen bonds has been crystal neutron diffraction. A survey of the results supports the theoretical scheme sketched above, though it is not yet clear where centro-symmetry might set in.

Special interest attaches to a series of crystalline compounds (mostly acid salts, such as MHX_2 from an acid HX) where formally symmetrical hydrogen bonding occurs: HX and X^- are crystallographically indistinguishable, and X-ray analysis shows that these residues are connected by a short hydrogen bond in which the acidic hydrogen atom participates. Although these bonds are always 'short,' O . . . O is not usually as low as 2·45 Å, so that merely statistical centro-symmetry of the proton might obtain. However, Bacon and Curry, by neutron diffraction studies on potassium hydrogen bis-phenylacetate, find a central proton, with its 'peak' showing no evidence of the elongation in the O . . . O direction, which would be expected if the protons statistically occupied alternative sites on either side of the mid-point. A similar conclusion was reached by Peterson and Levy for the intramolecular hydrogen bond in the hydrogen-maleate anion.

Recently studied by X-rays, though not yet by neutrons, is sodium hydrogen diacetate [$NaH(C_2H_3O_2)_2$]; here the O . . . O distance in the crystallographically symmetrical hydrogen bond is possibly as short as 2·43 Å. Like, but more markedly so than other such acid salts, this acetate gives a most anomalous infra-red spectrum; and this must be associated with the presence of these very short (and perhaps genuinely symmetrical) hydrogen bonds.

CARDIFF AND DISTRICT

Domestic Evening. At a joint meeting with local members of the Society of Chemical Industry at the Kings Head Hotel, Newport, on 18 November, 1959, two lectures were given. Dr N. E. Williams, of Monsanto Chemicals Ltd, gave an address on 'Co-polymers of Butadiene and Styrene' and Dr E. Boehm of the Nipa Laboratories Ltd spoke on the 'Applications of Anti-oxidants in relation to Foodstuffs.' The vote of thanks was expressed by Mr J. R. Millar.

The Work of the Railway Chemist. A lecture under this title was given at University College, Cardiff on 11 December by Mr E. D. Henley of the British Transport Commission, Research Department. The meeting was held jointly with local members of the Society of Chemical Industry and the Society for Analytical Chemistry.

The lecturer said that as his department covered a wide field of activity he would divide his lecture into two main parts—analytical and advisory. The first, said Mr Henley, dealt with a great range of materials, metallic and non-metallic, paints, plastics, lubricants, diesel fuel-oil, diesel exhaust gases, boiler waters, drinking waters and even foodstuffs, mineral waters and refreshments. The spectrograph, used to determine trace elements in lubricating oils, one of the many special pieces of apparatus employed, was illustrated with slides.

In its advisory capacity, the Research Department carries out many tests on the various plastics which are used to great advantage in passenger compartments and in buildings. Much research has been carried out on detergents used in the washing of carriages. Diesel-powered coaches are especially difficult to clean and

maintain free from grease and dirt. Weeds growing in the permanent way are controlled by spraying from special tanks with a variety of selective weed killers; sleepers made of timber require preservatives. Concrete sleepers, though occasionally used, are unpopular with the engineers; they are less resilient than wood, and in the event of a derailment cause greater damage to the track. The B.T.C. has its own police force equipped with a forensic department which is called upon to deal with a variety of problems. The lecturer illustrated with slides the work done to decipher the true date of issue on a defaced season ticket. Mr Henley concluded by saying that his department was a 'jack-of-all trades' and, he hoped, 'master of some.'

The vote of thanks was proposed by Dr N. M. Cullinane and Mr J. D. Thomas.

Rocket Exploration in the Upper Atmosphere. A lecture was given on this subject by Dr P. Reasbeck of the Research Department of Joseph Lucas Ltd, Birmingham, at the Kings Head Hotel, Newport, on 20 January.

Before the meeting, the Chairman, Mr H. K. B. Rout, expressed the deep regret felt by the Section at the sudden death of Dr E. Boehm, who had lectured to them only two months previously. The meeting stood for a short period in silence.

Dr Reasbeck began his lecture with a brief description of the historical background and speculations of the early scientists, and spoke of the investigations of Scheele, Lavoisier, Regnault and Bunsen into the composition of the earth's atmosphere. Balloons were an early source of experiment, and the earliest recorded balloonists to make a successful ascent and return alive were a sheep, a cock and a duck. Human investigators followed these pioneers right to the time of the famous Professor Picard. For the latest investigations, rockets are used to propel specially fitted cast-iron cannisters up to heights of 60 miles and more. One such cannister, recovered from the Nevada desert after a successful flight, was shown to the audience. Before being propelled aloft, cannisters are very thoroughly evacuated, and elaborate and ingenious attachments are fitted to open the valves and allow air to enter the cannister so as to obtain a sample as free as possible from danger of contamination by the products of combustion of the last booster rocket, and to close the valves again and seal the sample ready for its descent. Experiments have shown that at heights of about 60 miles there is diffusive separation of the lighter gases. As well as many slides, two splendid sound and colour films were shown illustrating the spectacular launching—successful and otherwise—of German rockets, with warheads removed and replaced by instrument cones. Another film showed the work leading to the successful launching of some American rockets at Cape Canaveral and drew a picture of the immense amount of work connected with the sending of these vehicles into the air. The lecturer concluded with a brief description of the many other investigations now being undertaken, measurements involving the ionization density in the E layers, the low-energy end of the solar spectrum and cosmic radiation belts surrounding the earth.

The lecturer answered a great many questions from a keenly interested audience, including some from sixth-formers. The vote of thanks was proposed by Mr G. M. Kerman.

CUMBERLAND AND DISTRICT

Chemical Applications of Nuclear Resonance. On 12 November, 1959, Mr J. H. Tonkin took the Chair at the County School, Seascale, when Dr R. E. Richards gave a lecture on 'Recent Advances in the Chemical Applications of Nuclear Resonance.'

Dr Richards briefly described the basic theory. A charged nucleus in an applied field (H_0) simulates a magnet having spin angular momentum defined as for an electron. Quantum mechanics limits the number of possible orientations for this nucleus, their maximum energy difference being $\Delta E = \mu H_0/I$ where μ is the magnetic moment and I the value of the nuclear spin. Transfer from one energy level to another is effected by applied radiation (frequency ν) and a state of resonance exists when $\Delta E = h\nu$. Hydrogen shows a resonance frequency at about 42 Mc/sec and lithium–7 at about 16·5 Mc/sec in a magnetic field of 10^4 gauss.

Adjacent nuclei modify the effective field in solids (salts) and internuclear distances can be determined. The many nuclei usually present in organic solids spread the resonance peak into a band of about 10 gauss. Greater precision is possible for liquids (line widths 10^{-5} to 1 gauss) because of the random motion of the nuclei, magnetic fields averaging to zero.

The proton resonance frequency varies, due to local magnetic shielding; characteristic frequencies are therefore obtained for alcohols, aldehydes, ketones, and so on, whereas that of a methyl hydrogen depends upon the methyl group's environment. The technique can thus decide between alternative possible structures of compounds, for example, diketene and steroids.

Measurement of the two resolved peaks of the cobalt compounds permits calculation of the rate constant at various temperatures for the equilibrium

$$Co(NH_3)_6^{3+} + 3\ en \rightleftharpoons Co\ en_3^{3+} + 6\ NH_3$$

A current is induced in the electron cloud of an atom in a magnetic field, and such currents are responsible for diamagnetism, reducing the applied field so that $H_{red} = H_0\ (1 - \sigma)$, where σ is the chemical shift factor. When a long molecule has its main axis parallel to the magnetic lines of force there is a considerable shielding effect as diamagnetic moments are easily induced. When at right angles, however, there is a lower axial symmetry of the electron cloud about the field and smaller moments are induced. Application to solute–solvent association studies has shown, for example, that

the acetylenic hydrogen is above and below the aromatic ring in benzene solutions of acetylenes.

Although the ions of thallous hydroxide partly associate to form ion-pairs in solution, only one resonance line occurs, because of rapid chemical exchange with Tl^+. The equilibrium constant calculated from resonance measurements for various concentrations of this hydroxide was compared with that obtained from spectrophotometric data.

Finally, Dr Richards described how proton peaks, for example in CH_2, CHO etc., show fine structure (doublets, triplets, etc.) under high resolution. Propyl and isopropyl radicals are distinguishable, and the position of the benzyl group in benzyl-azulenes has been studied.

The discussion included detailed description of the equipment and comparison with I.R. and Raman techniques. The vote of thanks was proposed by Dr E. Richardson of Whitehaven Technical College.

Zero-Valent Compounds of the Transition Elements. On 22 January Professor H. C. Longuet-Higgins, F.R.S., lectured on 'Zero-Valent Compounds of the Transition Elements.'

He defined a zero-valent compound as one whose structure could be represented so that the metal atom had a formal valency of zero. Illustrating this with reference to nickel carbonyl, Professor Longuet-Higgins showed that it was in fact possible to write two formal structures for this compound, in one of which the nickel appeared to have a valency of zero and in the other a valency of eight. The two structures had one feature in common: the nickel attained a closed valency shell of 18 electrons. Taking this as the criterion, the structure and stability of nickel carbonyl could be rationally explained in terms of the molecular orbital theory by considering the spatial configuration of the available bonding orbitals. This treatment was then extended to explain the structures of compounds such as ferrocene and chromium dibenzene in which the metal atom is sandwiched between two cyclic conjugated polyenes. In these and other cyclopentadienyl complexes of the transition elements the metal attains a closed valency shell of 18 electrons by making use of those π and σ orbitals of the co-ordinating molecules which have suitable charge distributions to overlap satisfactorily with available electronic orbitals of the metal atom. By pursuing this theoretical argument it was postulated that stable complexes of cyclobutadiene, in which the cyclobutadiene would contribute four π-bonding electrons to the 18-electron shell, should be capable of existence. This prediction was made four years ago and, only recently, stable complexes of cyclobutadiene have in fact been isolated; this provides striking support for the theory.

Professor Longuet-Higgins went on to discuss more complicated polynuclear complexes of related type and showed how their established structures could be satisfactorily accounted for on the molecular orbital theory.

After a short discussion, Professor Longuet-Higgins concluded by inviting the audience to suggest an explanation for the structure of a certain complex of iron which so far has completely baffled even the theoretical chemists. Needless to say, this question is still unresolved.

HUDDERSFIELD

Colour Characteristics in Photography. On 7 December, 1959, a joint meeting with the Chemical Society of the Huddersfield College of Technology was held at the College. Mr B. W. Coe of Kodak Limited, gave a lecture on 'Colour Characteristics in Photography.'

In dealing with the physical and chemical aspects of colour photography, Mr Coe explained how the original 'additive' process has now been replaced by the current 'subtractive' processes. All aspects of the subject were strikingly illustrated with colour slides, some of which gave the impression that the appreciation of the accuracy of a colour photograph is influenced by a combination of physical, physiological and psychological factors.

The lecturer was thanked by Mr F. Schofield, and also by Mr A. Marsden, on behalf of visitors from various local photographic societies.

Nylon in Industry and Fashion. On 12 January, Mr H. Armitage, of British Nylon Spinners Ltd, lectured at Whiteley's Cafe, Westgate. Dr I. Tittensor presided.

Following the work of Carothers of Du Pont in the United States, the first nylon in the United Kingdom was made almost 20 years ago in the Imperial Chemical Industries plant at Huddersfield. War-time use of nylon was restricted to essential military purposes, glider tow-ropes and parachute canopy fabric, but with peace a programme of end-use development linked with increased yarn production from a new factory in Pontypool, enabled British Nylon Spinners Ltd to become a novel force in the world of textiles. The remarkable versatility of nylon makes possible a range of end-uses which run from the most feminine of fripperies to the most functional of tasks in heavy industry and in the Services—from 9-denier stockings to conveyor belting, from glamorous lingerie to lightweight tarpaulins, from corsetry to bullet-proof vests.

The common strand throughout these manifold uses is the yarn itself. Its combination of properties, great tensile strength, excellent recovery from extension, low moisture absorption, outstanding capacity to accept shock loadings, to name but a few of its principal attributes, render it a uniquely serviceable yarn for heavy-duty ocean tow-ropes, 'no-darn' socks, hard-wearing carpets, upholstery, sleek-fitting stockings, quick-drying lingerie, sheets and shirts, tyre-cords to

meet the stress of racing and of the new motorways, and many hundreds of other uses where the presence of nylon has made possible the attainment of new peaks of elegance and comfort in daily life, in industrial output and efficiency, and in overall economy of operation.

Many ladies took part in the discussion which followed the lecture, and considerable interest was taken in a comprehensive display of exhibits based on nylon. Mr J. Pugh proposed the vote of thanks to the lecturer.

HULL AND DISTRICT

Gas Chromatography. The facilities of the University of Hull were placed at the disposal of the Section on 9 January for a Symposium on Gas Chromatography which was very well supported. Several short papers were given, with discussion after each.

During the morning session Mr G. Colman Green was in the Chair, and the Symposium was formally opened by Professor N. B. Chapman. Papers were presented on 'Recent Developments in Gas Chromatography'; 'Gas Chromatography in the Service of the Perfumer'; and 'The Application of Gas Chromatography to the Analytical Problems of the Fat and Fatty Acid Industry.'

During the afternoon session Dr S. N. H. Stothart was in the Chair and the following papers were given: 'Fundamental Applications of Gas Chromatography' and 'Construction and Use of Gas–Liquid Chromatography Apparatus for an Analytical Laboratory.'

There was then a general discussion and the final summing up was made by Mr R. P. W. Scott.

The Symposium was supported by a Trade Exhibition of Gas Chromatography Apparatus, Materials and Textbooks.

This is the first time that the Section has arranged a Symposium of this type, and its unqualified success must mean that similar proceedings will be considered in future years.

Corrosion of Iron and Steel. A joint meeting with the Hull Chemical and Engineering Society, under the Chairmanship of Mr W. H. Potter, was held on 19 January, at the Queen's Hotel. Dr D. E. Davies, of the department of metallurgy, University College of Swansea, gave a lecture on 'Some aspects of the Corrosion of Iron and Steel.'

Dr Davies began by giving some statistics on the annual cost of corrosion to the United Kingdom, which has been estimated at about £600,000,000.

Dr Davies reviewed the basic principles of electrolytic corrosion in terms of the simple anode/cathode/electrolyte system and discussed the effect of cathode dimensions and the role played by oxygen. He outlined in some detail the apparatus for measuring corrosion at high oxygen pressures. Dr Davies then discussed corrosion inhibitors, both of the anodic and cathodic types and showed how the action of inhibitors could be followed by the measuring of corrosion potentials.

After an interesting discussion, reflecting the interest which Dr Davies's lecture had created, the vote of thanks was proposed by Dr Stothart and seconded by Mr A. P. Backshell.

LEEDS AREA

Aromatic Fluorocarbons. A meeting was held at the University of Leeds on 18 January, when Professor J. C. Tatlow gave a lecture on 'Aromatic Fluorocarbons.' Professor W. Bradley was in the Chair.

The action of fluorinating agents on benzene tends to produce fluorinated cyclohexanes, but hexafluorobenzene can be prepared from these. Numerous exchange reactions can be effected with fluorine on the benzene nucleus, leading to many novel and interesting aromatic compounds. Some account of the possibilities will be found in the article on 'Progress in Organic Fluorine Chemistry' (*J.*, 1960, 11).

After a full discussion Dr D. McNeil proposed the vote of thanks expressing the interest of members in this prolific field of investigation and their appreciation of the lecturer's presentation and enthusiasm.

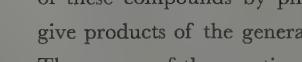
LONDON

New Developments in the Chemistry of Free Radicals. On 25 November, 1959, a meeting was held at the South West Essex Technical College. The Chair was taken by Mr A. J. Turnbull and the lecture was given by Dr Williams.

The lecturer first pointed out that one interesting aspect of the chemistry of free radicals is the arylation of aromatic compounds by a free radical mechanism. Suitable free aryl radicals may be generated either by the thermal decomposition of aromatic diazo compounds at about room temperature or by the slower thermal decomposition of dibenzoyl peroxide, which requires about three days at 80°C for completion. This latter process is preferred, partly because it is a comparatively clean reaction which occurs without the formation of any tarry by-product.

The decomposition of dibenzoyl peroxide probably occurs mainly by the mechanism:—

$$(C_6H_5COO)_2 \rightarrow 2\ C_6H_5CO{\cdot}O{\cdot}$$
$$C_6H_5CO{\cdot}O{\cdot} \rightarrow CO_2 + C_6H_5{\cdot}$$

If this decomposition is allowed to take place in the presence of other aromatic compounds, then substitution of these compounds by phenyl radicals takes place to give products of the general type 
The course of the reaction is analysed by determining both the partial rate factor in competitive substitution using benzene as a reference standard, and by the isomer ratio.

It has been found that most simply substituted benzenes, except t-butyl benzene, react more readily than benzene with free aryl radicals and that polar

substituents have comparatively little effect on the rate of substitution, in contrast to the effect of such substituents on the rate of both electrophilic and nucleophilic substitution. This is because the phenyl radical is not markedly either electrophilic or neucleophilic.

The general course of these reactions is supported qualitatively and approximately quantitatively by theoretical calculations based on considerations both of the free valence in the ground state at the possible sites of substitution and of atom localization energy in the transition states.

It is hoped that further progress will be made as a result of experimental work now being carried out to find a fresh source of aryl radicals suitable for this type of study. The most promising compound considered in recent work is triphenyl bismuth, which, when irradiated by ultra-violet light, decomposes to give phenyl radicals and bismuth.

A vote of thanks was proposed by Mr A. W. Ellis.

Nuclear Magnetic Resonance. On 10 December, Dr R. E. Richards lectured on this topic to a large audience at the Northampton College of Advanced Technology, London. The chair was taken by Mr F. C. Hymas.

Starting from the concept of quantized nuclear spin, the lecturer showed how this would interact with a superimposed magnetic field. The possible resonance absorption of such a system in a radio-frequency field was then examined, and a clear picture of the origin of the term 'nuclear magnetic resonance' emerged.

The two usual methods for plotting an N.M.R. spectrum were outlined, and the general features of such plots were discussed. In the case of simple crystals it was shown how the inter-nuclear distances could be investigated, and how alteration of line width with temperature could be used to obtain information about molecular motion in solids, *e.g.* ammonium chloride.

From a consideration of inter and intra-molecular forces in liquids, the significance of the line shift and the importance of line width in N.M.R. studies was explained.

The lecturer then examined the application of N.M.R. methods to some structural problems in organic chemistry. The orientation of the benzyl azulenes, the structure of diketone and the identification of straight and branched chain isomers were among the topics surveyed, and the extremely detailed information which could be obtained by N.M.R. was demonstrated. In case the audience felt that the technique was restricted to a study of organic liquids, Dr Richards then discussed the information which N.M.R. could give about the nature of thallous hydroxide solutions. (*see* p. 107).

The vote of thanks was proposed by Dr J. Leicester.

MANCHESTER AND DISTRICT

Exhibition of Laboratory Apparatus and Techniques. The annual exhibition of the Section, held on 7 and 8 January, filled two large laboratories in the Department of Chemistry of the Manchester College of Science and Technology. The exhibition was first organized in 1952 to show new apparatus and methods developed in the many research laboratories in and near Manchester; it includes commercial exhibits and over the years has possibly become the largest of its kind outside London.

On this occasion 39 exhibitors occupied some two thousand square feet of bench and floor space. Exhibitors included all the main laboratory furnishers and many manufacturers of and agents for glassware and capital equipment. For the first time there was a display of scientific books from one of the leading booksellers. A number of continental manufacturers exhibited through their agents in this country. Most of the firms exhibiting were those with head offices or branches in the North-West, but a number from further afield—London, Tyneside and the Midlands for example —supported the exhibition. We hope to attract more of these firms to show in Manchester in the future.

Numerous examples of all types of laboratory apparatus were shown, for example, glassware—both stock lines and custom-built; textbooks and reference books; fused silica equipment; stands and bench supports; ovens, incubators, water baths and thermostats; autoclaves and furnaces; vacuum pumps; pH meters of many types; gas analysers and recorders; industrial recording and control equipment; microscopes and accessories; stirrers in wide variety; automatic titrators; microzone-melting apparatus; liquid and vapour phase chromatography equipment; balances —direct reading and recording; centrifuges; stills and de-ionizing columns; colorimeters; electrophoresis apparatus; filter and chromatography papers; and accessories in PVC, polythene, nylon, PTFE, silicones, neoprene and so on.

Many of these exhibits were newly developed and on show for the first time and were specially marked to distinguish them in the exhibition. A 40-page catalogue listing the exhibits was widely distributed beforehand.

It is always difficult to obtain accurate figures of the total number of attendances, as entry to the exhibition is open to all interested without restriction and it is widely advertised in laboratories in the North-West. Probably over a thousand members of the Institute and other chemists and scientists visited the exhibition during the two days it was open.

This exhibition is now well established in its own right and there appears to be no necessity to link it with the Section's Annual General Meeting as has been the practice in the past. There is no reason why it should not develop into a fully representative national exhibition, and invitations will probably be extended in future to all the important manufacturers of instruments and equipment in the country. Even now it presents a unique opportunity to see a wide variety of equipment assembled in one place, to compare the different types on show and to discuss one's special

requirements with the technical representatives of the manufacturers showing. The Manchester Section is justifiably proud of this service to Institute members and indeed to all scientists in the North-West. The facilities at the College of Science and Technology are excellent and the Section is very grateful for the hospitality and help extended by the College authorities, and particularly to the staff of the Chemistry Department.

NORTH LANCASHIRE

The Surface Energy of Solids. A joint lecture with the Lancastrian Frankland Society took place on 14 January and was given by Dr S. J. Gregg. Mr C. D. Lafferty was in the Chair.

Dr Gregg began his lecture by discussing the field of force at the surface of solids and its relevance to phenomena such as adsorption, spreading and adhesion, and showed its relation to the concept of surface energy. The effect of adsorption of gases or vapour, which resulted in a considerable reduction in surface energy, was shown by reference to graphs from experiments relating the angle of slip of a thin solid cylinder inside a tube to the water vapour pressure in the container.

The lecturer then went on to show the relevance of these ideas in a number of different fields. He pointed out that adhesion of solids will be diminished by the presence of vapour so that the bulk (or packing) volume should be less in the presence of, for example, water vapour than in vacuum. Small or thin particles should stick to one another or to larger particles more easily than larger particles adhere to one another. Thus fine powders aggregate more readily and disperse less readily in air than do coarse powders. This aggregation is important in grinding, where it limits the extent of size reduction and leads to a 'grinding equilibrium.' Finally the role played by adhesion in the sintering of powders and in the preparation of 'active' solids by calcination was briefly mentioned.

After a most interesting discussion Dr G. R. Gedye proposed the vote of thanks.

Crystal Gazing. The joint lecture with the Blackburn Philosophical and Scientific Society for Sixth-Form Grammar-School pupils was given in Blackburn on 15 January by Professor H. Lipson, F.R.S. Mr L. W. C. Maidment was in the Chair.

Professor Lipson began his lecture by explaining its title:—the enormous amount of work done by early crystallographers in the classification of crystals by visual examination. He then went on to show how with the aid of simple models it was possible to build up units that have planes and angles corresponding to natural crystals. He demonstrated the rapid growth of crystals by reference to sodium thiosulphate and a 'chemical garden.'

The lecturer then discussed the principles of X-ray and electron-diffraction techniques and the remarkable advances made in the studies of molecular structures with their aid.

Mr Lafferty proposed the vote of thanks.

Liquefaction of Gases. The Preston Young Peoples' Lecture arranged jointly with the Preston Scientific Society was given by Dr S. A. Miller of British Oxygen Research and Development in the Avenham Institute on 29 January. Dr Miller spoke on 'The Liquefaction of Gases' and Dr Wilkinson, Chairman of the Preston Scientific Society and Principal of Harris College, was in the Chair.

Dr Miller described the experiments of Faraday who liquefied several gases by generating them under pressure in sealed tubes. He then went on to explain, with the aid of graphs relating pressure and volume, how Andrews demonstrated that a gas cannot be liquefied unless it is cooled below its 'critical temperature.' Low temperatures can be produced by rapidly evaporating volatile liquids, by the Joule–Thompson throttled expansion and by expansion with the performance of external work. All these processes have been used in the construction of practical liquefiers.

After explaining the fundamental aspects of distillation Dr Miller detailed the production of oxygen and nitrogen from liquid air and described a typical modern air-separation unit, including the devices used for separating the rare gases. He then gave numerous examples of the large-scale uses of oxygen in industry and some details of the economics of oxygen production in gaseous and liquid form.

The lecture was followed with numerous educative and entertaining demonstrations of the physical and chemical properties of liquid oxygen.

Mr Lafferty proposed the vote of thanks.

NORTH WALES

Onium Salts and Related Compounds. On 20 January, Dr D. W. A. Sharp of the Imperial College of Science and Technology gave a lecture at Flintshire Technical College, Connah's Quay on 'The Preparation and Structures of some Onium Salts and Related Compounds.' Mr F. Holmes, Chairman, presided.

Dr Sharpe said onium salts contain cations derived from the non-metallic elements; these cations are generally linked to aromatic groupings and are stabilized by conjugation. Triphenylchloromethane reacts with silver salts of complex fluoro-acids dissolved in organic solvents to give triphenylmethyl carbonium salts. Infra-red spectroscopy has shown that the cations in these salts have a planar propeller-like structure. Other carbonium salts studied have included tri-*p*-anisylmethyl hydrogen dichloride, which contains the HCl_2^- ion. Aminium salts are prepared by oxidizing triarylamines with the solutions containing iodine cations which result from the interaction of soluble silver salts and iodine in ether. The tri-*p*-tolylaminium free-radical cation is also planar, propeller-like in structure.

Tertiary aromatic amines have been shown to have some basic properties, forming adducts with boron halides and, under suitable conditions, forming triarylammonium salts. Infra-red spectroscopy has shown that triphenylamine also probably has an almost planar arrangement about the central nitrogen atom in the solid state—a result in agreement with other physical measurements.

It seems that, in the presence of aromatic groupings which tend to delocalize the electrons present on the central atom, the actual configuration of an onium cation or related molecule does not depend upon the number of these electrons.

STIRLINGSHIRE AND DISTRICT

Ladies' Evening. On 2 December, 1959, a Ladies' Evening was held jointly by the Section and the Society of Chemical Industry. This was an innovation and it was gratifying to note the good attendance.

The meeting was addressed by Mr A. R. Graham of Imperial Chemical Industries Ltd, who spoke on Terylene. Mr Graham introduced his talk by pointing out that Terylene is the only synthetic fibre discovered and developed in this country. He outlined its discovery by Whinfield and Dickson of the Calico Printers' Association in 1941 and its development by Imperial Chemical Industries Ltd at a cost of £20 million.

Terylene yarn is manufactured by extrusion from the melt—this results in a fibre in which the molecules are unorientated; the filament is then hot-drawn to orientate the molecules, and this stage imparts great strength and resilience to the fibres. The lecturer then dealt with the two main forms in which Terylene is supplied to processing firms: filament yarn, for sheer, light-weight fabrics, and staple yarn, which is simply crimped filament yarn cut into short lengths.

The industrial uses of Terylene were also dealt with briefly; its main valuable properties are resistance to acids, weathering and heat. Terylene is used for ropes, fire hoses, driving belts, sailcoth and so on. In these fields it may be up to ten times more expensive than its non-synthetic counterpart, but the working life is such that the use of Terylene is in most cases worth while.

After the lecture, members had an opportunity of examining and handling a wide range of articles of clothing prepared from Terylene in its various forms—an opportunity which was welcomed particularly by the ladies present. The Section is indebted to Marks and Spencer, Ltd, Falkirk, for the display of clothing.

The vote of thanks was proposed by Dr Magnus Pyke.

Chemistry and Criminal Investigation. At Falkirk on 27 January, Superintendent J. K. McLellan of the City of Glasgow Police addressed a combined meeting of the Section and the Society of Chemical Industry on 'Chemistry and Criminal Investigation.'

The speaker, who was introduced by Dr F. S. Fowkes, began his talk by emphasizing that police investigators have to cover a very wide field and it is not possible for such persons to have intimate, specialist knowledge of every branch of chemistry with which they might have to deal. For this reason, the police scientist has to rely, in part, on industrial scientists who are specialists in their own fields. Superintendent McLellan then jocularly remarked that his willingness to undertake the commitments of lectures was a reflection of the hope that he would thereby make further contacts with industry which could some day be of use to him. Examples were given of the help that can be obtained from industry, *e.g.* the provision and operation of a large electromagnet to drag the bed of the River Clyde in the Manuel case.

Just how wide the field of work covered by a police investigator may be was then revealed when the speaker proceeded to a succession of typical examples, illustrated with lantern slides and exhibits, of cases in which he had been involved.

Explosives are a regular feature of police detective work; they may be used for safe-blowing or for political activities, and it is a curious fact that practically all explosives used for safe-blowing are manufactured by one firm. Those individuals indulging in political activities, on the other hand, do not have either the same friends or resources, and a wide variety of explosives, many of them home-made, may be encountered—silver acetylide and fulminate of mercury for example. The solution of incidents involving such materials requires much finesse and delicacy.

At this point the speaker introduced a few words of propaganda about safes; there are two main types—those intended to protect documents from fire and those designed to resist attack. Considerable unnecessary trouble is caused when users confuse the two, since the latter cannot be opened with explosives, for if an attempt is made on one lock another comes into operation.

The medical side of police work is probably the most important, for example the examination of blood in cases of suspected gas poisoning, or for alcohol, barbiturates and so on. The last-named are perhaps the most common drugs that a police investigator may be asked to identify; three main methods are now available—extraction from the organs, purification and identification; paper chromatography; or the use of the absorption spectrograph at different pH values.

The audience was both entertained and enlightened by numerous descriptions of the way in which chemical methods have been used to solve various unusual crimes.

During the break for refreshments, members were at liberty to examine the extensive collection of exhibits; these ranged from a number of counterfeit banknotes to a home-made bomb which had been dropped into a police box but failed to explode.

After a number of questions had been ably answered, the vote of thanks was proposed by Mr Creegan.

News and Notes

FELLOWSHIPS AND GRANTS

Ramsay Memorial Fellowships.—The Trustees will consider in June applications for two Ramsay Memoral Fellowships for advanced students of chemistry. One of the Fellowships will be limited to candidates educated in Glasgow, who can apply to be considered for either Fellowship. The value of each Fellowship will be £600 per annum, to which may be added a grant for expenses of research not exceeding £100 per annum. The Fellowships will normally be tenable for two years.

Full particulars can be obtained from the Joint Honorary Secretaries, Ramsay Memorial Fellowships Trust, University College, Gower Street, London, W.C.1. Completed application forms must be received not later than 11 April, 1960.

Rockefeller Foundation Grants.—The Foundation has recently announced a number of grants to academic and scientific bodies in Britain and other parts of the Commonwealth. They include grants to Churchill College, Cambridge; St Catherine's and St Antony's Colleges, Oxford; The School of Oriental and African Studies, University of London; The London School of Hygiene and Tropical Medicine; The Indian International Centre at Delhi and the Commonwealth Scientific and Industrial Research Organization, Australia. An individual grant of $1,600 (£570) has been made to Sir John Cockcroft to attend the federal science congress in Salisbury, Southern Rhodesia.

EDUCATIONAL

Careers Meetings in Glasgow.—Included in the Annual Series of Careers Meetings in the St Andrews' Hall, Berkeley Street, Glasgow, are lectures on Medical Laboratory Technology, the Scientific Civil Service and Textile Technology on 4 April; Chemical Engineering, Mining Engineering and Metallurgy on 5 April; Pharmacy and Microbiology, Agriculture Horticulture and Forestry, and Food Science on 7 April; and Applied Mathematics, Chemistry and Physics on 12 April. All meetings begin at 7.30 p.m. Further particulars may be obtained from the Youth Employment Service, Careers Office, 196 Bath Street, Glasgow, C.2.

Diploma in Biochemistry.—The Regulations covering the postgraduate course in biochemistry leading to the Diploma of Chelsea College state that Fellows, Associates and Graduate Members of the Institute are eligible for admission to the course. Further particulars may be obtained from the Department of Chemistry, Chelsea College of Science and Technology, Manresa Road, London, S.W.3.

Diploma in Technology.—Eight candidates have been awarded the Diploma in Technology by the National Council for Technological Awards for work at the Birmingham College of Advanced Technology, on an approved honours course in applied chemistry, and industrial training at various firms, over the period July 1955 to December 1959.

The latest figures issued by the Council show that there are now 359 students on Dip. Tech. courses in applied chemistry, chemical technology or industrial chemistry, 162 of whom are in their first year. There are now eleven sandwich courses and two full-time courses leading to a Dip. Tech. in these fields. Of the above 162 students, 118 qualified for entry by means of appropriate G.C.E. subjects and 42 through an O.N.C.

In all subjects, there are now 3746 students on 72 sandwich and 15 full-time courses leading to Dip. Tech.

Health Physics.—A summer school in Health Physics (Radiation Protection), arranged by Dr H. D. Evans, will be held in the Nuclear Technology Laboratories, part of the Department of Chemical Engineering and Chemical Technology, Imperial College of Science and Technology, London. The course, which will begin on 4 July, will be for two weeks and the syllabus will include lectures on Introductory nuclear physics; Units of radiation and radioactivity; Biological effects of radiation; Maximum permissible levels; Health Physics instrumentation; Biological monitoring procedures; Hazard control and laboratory design; Decontamination and waste disposal; Organization of radiation protection services; and Regulations, national and international. There will also be practical work and visits to other establishments in the London area. Accommodation will be available in college hostels and the fee for the course, exclusive of residence, will be 25 guineas. Applications should be made to the Registrar, Imperial College, London, S.W.7.

Nottingham's Agricultural Sciences Building.—The new £240,000 building of the University of Nottingham's School of Agriculture at Sutton Bonnington was opened on 15 January by Sir William Slater, K.B.E., F.R.S., Secretary of the Agricultural Research Council (*J.*, 26). Sir William stressed the importance of allowing the scientists who would work there to follow lines of research of their own choosing. This would mean the allocation of sufficient money by the University, but if special problems arose involving additional expense an appeal could be made to such bodies as the Agricultural Research Council.

SOCIETIES AND INSTITUTIONS

Corrosion Science Society.—A new society has been formed to promote the advance of corrosion science and its application to the solution of practical problems, to organize meetings and to co-operate with other professional individuals, societies and institutes with

interests in the corrosion field. The first meeting will take place on 4-5 April at Battersea College of Technology when 15 papers will be presented and discussed. There will be an informal dinner on the evening of 4 April. Further particulars may be obtained from Dr T. P. Hoar, Department of Metallurgy, Pembroke Street, Cambridge.

Institution of the Rubber Industry.—New Sections of the Institution are to be established in Ceylon and Rhodesia. They will work to promote the development of polymer science and technology, to encourage technical education and provide a means of association between persons engaged in the rubber industry in those countries.

Applications seeking the necessary permission have been received from provisional committees set up in Colombo and Bulawayo; they were unanimously approved at a recent meeting of the Council of the Institution.

MEETINGS AND EXHIBITIONS

Analytical Chemistry in the Service of Agriculture.—A symposium organized by the Midland Section of the Society for Analytical Chemistry will be held at the University of Nottingham on 14-15 July. Papers will be presented on the determination of pesticide residues; the determination of metals in soils and plants; analytical aspects of dairy farming; the determination of systemic insecticides; analysis of herbicides; the protection of the consumer against harmful effects of pesticide residues; and the determination of additives in feeding-stuffs.

The programme will also include a visit to a horticultural or agricultural research station in the district. The fee for the symposium will be three guineas, and an informal dinner at a cost of one guinea will be held on 14 July.

Registration forms and further information may be obtained from Mr C. A. Johnson, Standards Department, Boots Pure Drug Co. Ltd, Station Street, Nottingham.

Biologically Important Macro-Molecules.—The Department of Science at Birkenhead Technical College has arranged a one-day symposium on 'Recent advances in the study of biologically important macromolecules' for 26 March. The chairmen for the two sessions will be Professor G. W. Kenner and Lord Cohen of Birkenhead. Four papers will be presented on 'Recent results of physical methods of structural examination of high molecular-weight natural products'; 'Structural studies of fibres'; 'Structural studies on peptides'; and 'Synthesis of peptides.'

Those interested should apply immediately to the Head of the Science Department at the College. There will be a fee of 9s. 6d. (lunch included).

Chemical Institute of Canada.—The 43rd Annual Conference and Exhibition of the Chemical Institute of Canada will take place at the Chateau Laurier, Ottawa, from 13 to 15 June. It is expected that there will be some 40 different displays of new chemicals, instruments and process equipment in the Exhibition. Tours will be arranged and there will be a varied social programme. At the technical sessions papers will be presented in the fields of biochemistry, analytical chemistry, chemical education, chemical engineering, chemical economics, organic and inorganic chemistry, physical chemistry and protective coatings.

A full programme may be obtained from the Chemical Institute of Canada, 48 Rideau Street, Ottawa 2.

Continuous Culture of Micro-Organisms.—The Microbiology Group of the Society of Chemical Industry has arranged a symposium on the Continuous Culture of Micro-Organisms, at University College, London, from 31 March to 1 April. A registration fee of £3 (30s. to members) will be charged. Further details and a registration form may be obtained from the Assistant Secretary, S.C.I., 14 Belgrave Square, London, S.W.1.

Dechema Annual Meeting 1960.—The Annual Meeting of the Dechema Deutsche Gesellschaft für Chemisches Apparatewesen will be held in Frankfurt from 14 to 16 June in conjunction with the 26th meeting of the European Federation of Chemical Engineering. The principal lectures will be on physical and chemical properties of non-metallic protective coatings; the production and properties of electrolytically deposited metal layers; the mode of action of corrosion inhibitors; physical and chemical properties of laminated materials of construction. Further details may be obtained from DECHEMA, Frankfurt (Main) 7, Postfach, Germany.

High Polymer Forum.—The Tenth Canadian High Polymer Forum will take place at the Alpine Inn, Ste Marguerite, nr Montreal on 8-9 September. The Forum is sponsored by the National Research Council of Canada in co-operation with the Chemical Institute of Canada, and is devoted to all aspects of Polymer Science.

Authors wishing to submit papers for presentation are asked to write to the Programme Chairman, Dr K. E. Russell, Department of Chemistry, Queen's University, Kingston, Ontario.

Industrial Chemistry of Lower Olefins.—A symposium arranged by the Chemical Society, the Institute of Petroleum, the Society of Chemical Industry and the Institute will take place on 24 March in the Chemistry Lecture Theatre of the University of Manchester on 'The Industrial Chemistry of the Lower Olefins.' Papers will be read on the economics of ethylene production from naphtha; the production of ethylene oxide; industrial chemicals based on ethylene and propylene; the production and utilization of

butadiene; and newer developments in the polymerization of olefins.

A limited number of duplicated preprints are available at 10s. per set from Dr P. J. King, Chemical Engineering Department, Manchester College of Science and Technology, Sackville Street, Manchester 1.

Interpack 1960.—An International Exhibition of Packaging and a Display of Confectionery Machinery will take place in Düsseldorf from 20 to 27 April in conjunction with the 4th European Packaging Federation (EPF) Congress which will be held from 21 to 25 April. Further particulars may be obtained from Nordwestdeutsche Ausstellungs-Gesellschaft m.b.H., Ehrenhof 4, Düsseldorf, Germany.

Nuclear Chemistry and Radiochemistry.—A symposium on this subject will take place in Canada from 6 to 8 September at the Chalk River Laboratories of Atomic Energy of Canada Limited under the joint auspices of the company and the Inorganic Chemistry Division of the Chemical Institute of Canada. Topics to be discussed include the chemical and nuclear interactions of excited atoms, with range-energy relations and properties of recoil atoms; experimental studies of the fission process, with emphasis on the division of mass, charge and energy at low excitation energies; properties of nuclei, including new nuclides and new information on reaction cross-sections, half-lives and decay schemes; new techniques in nuclear chemistry, particularly in counting methods.

Those wishing to present papers are asked to submit long abstracts by 15 June. Enquiries regarding contributions and accommodation should be addressed to Dr R. H. Betts, Atomic Energy of Canada Limited, Chalk River, Ontario.

Training of the Industrial Physicist.—The Education Group and Midland Branch of the Institute of Physics are holding a joint conference on this subject on 21-22 April in Birmingham. Papers to be discussed include 'Problems of selection for Diploma in Technology and university degree'; 'The university degree and Diploma in Technology compared as a training for the industrial physicist'; 'Postgraduate training in physics'; and 'Requirements of industry.' Further details and registration forms are available from the Secretary, Institute of Physics, 47 Belgrave Square, London, S.W.1.

Wiggin Nickel Alloys in Industry.—An exhibition, by Henry Wiggin & Co. Ltd, similar to that previously staged, will take place at Park Lane Hotel from 21 to 25 March. During the exhibition a series of lectures will be given on subjects including 'Fabricating the High-Nickel Alloys.' The exhibition will be augmented by a continuous showing of films. Further details may be obtained from the company, Thames House, Millbank, London, S.W.1.

NEW AND RECENT PUBLICATIONS

Chemstrand Corporation.—The report of the tenth year of operation of the Chemstrand Corporation, recently published, makes particular mention of the Acrilan fibre plant of its British subsidiary, Chemstrand Limited, at Coleraine, Northern Ireland, which started up in 1959. Plants of affiliated companies in Japan and Italy also commenced operations in 1959. There are plans for a new-style plant in South Carolina, a nylon development centre connected to the Corporation's present nylon plant in Florida, and a research centre in North Carolina.

Coke and Chemistry U.S.S.R.—As part of the scheme inaugurated by D.S.I.R. for the translation of Russian technical journals, the Coal Tar Research Association, in collaboration with the British Coke Research Association, is producing an English version of *Koks i Khimiya* under the title *Coke and Chemistry U.S.S.R.* The first issue consists of the journal for August, 1959, and specimen copies are available free on request. The annual subscription is five guineas (12 issues) and single issues may be purchased at 20s. each. There is a 50 per cent reduction on the subscription price for libraries of universities and technical colleges. Subscriptions should be sent to The Librarian, The Coal Tar Research Association, Oxford Road, Gomersal, Leeds.

Coke News.—The first issue of a new publication produced by the British Coke Research Association (in the form of duplicated sheets in a stiff folder) has just appeared.

The primary object of the news-sheet is to tell industry at large, as quickly and concisely as possible, of research results of general or specific importance. The new publication will not be circulated regularly but only when the occasion arises. Further particulars may be obtained from the Information Officer of the Association, Chesterfield, Derbyshire.

IUPAC Information Bulletin.—Information Bulletin No. 10 of the International Union of Pure and Applied Chemistry (Butterworths Scientific Publications, December 1959) is a useful reference document. It sets out to give a concise account of the Union's activities under the headings: What It Is; What It Does; How It Does It; and How It Is Supported. A list of National Adhering Bodies follows, together with a chart showing the structure of the Union. Other sections consider financial questions, relations with the International Council of Scientific Unions (ICSU), relations with member countries and the activities of the Sections and Commissions.

Perhaps the most significant section in this Bulletin is the Report of the Commission on Atomic Weights which recommends the adoption of a new scale based on the whole number 12 as the atomic weight (nuclidic mass) of the dominant natural isotope of carbon. This

recommendation is made subject to the provision that action is taken by the International Union of Pure and Applied Physics to recommend the adoption of the same scale. If the Union of Physics does so at its General Conference in 1960, the Commission hopes that approval by IUPAC will follow at its Conference in 1961, when a table of atomic weights based on the ^{12}C-scale would be published. An article on this subject will be published in the *Journal* shortly, probably in April.

The following meetings in this country are noted in the Calendar for 1960:

31 March to 1 April, Symposium on Continuous Culture of Micro-organisms (London)
4-6 May, International Symposium on Distillation (Brighton)
8-10 June, 3rd Symposium on Gas Chromatography (Edinburgh)
21-30 July, International Nuclear Power Exhibition (London)
14-19 August, 3rd International Congress of Clinical Chemistry (Edinburgh)
15-24 August, 5th General Assembly of the International Union of Crystallography (Cambridge)

STAFF COLLEGE FOR SENIOR TECHNICAL TEACHERS AND INDUSTRIAL STAFF

On 4 February Sir Alexander Fleck, K.B.E., F.R.S., with the support of Sir David Eccles, Minister of Education, appealed to industry to help in the establishment of a staff college for senior teachers in colleges of technology and commerce and senior industrial staff. He is asking industrial and commercial firms to contribute £100,000 as a single, once-and-for-all contribution, of which £60,000 has already been promised after private approaches to 30 firms. The running costs, amounting to about £30,000 a year, will be paid mainly from public funds.

The College will provide a centre where the senior staff from all types of colleges giving technical and commercial education, and senior representatives of industrial and commercial firms and others with similar interests can exchange ideas and experience. The college will benefit industry and commerce directly by giving their staffs a closer link with the technical colleges, and indirectly by improving the quality of the young men whom they will recruit in the future.

In a letter to about 250 firms, Sir Alexander says that the proposal to establish a staff college was included in the recommendations of the report of the Willis Jackson Committee on the Supply and Training of Teachers for Technical Colleges and has won the strong support of people in both industry and education, including the F.B.I. Education Committee, the associations of local authorities and teachers, the National Advisory Council on Education for Industry and Commerce and the National Advisory Council on the Training and Supply of Teachers. 'I myself consider the scheme to be of the greatest possible importance and promise,' says Sir Alexander. 'I think that co-operation between industrial and commercial firms on the one hand and the public system of education on the other is essential for the teaching of advanced technology; and I believe that industry should accept a measure of financial and administrative responsibility for the proposed college.'

Sir David Eccles says in a letter to Sir Alexander Fleck that as this is a 'wholly new departure in the British educational system,' its success must depend on the full and whole-hearted support of the local authorities who employ the teachers and of industry. In his view it was wise to regard the college from the outset as a joint enterprise, to which the Ministry, local authorities and industry all made an appropriate contribution.

Sir David welcomes the suggestion that the major contribution of industry and commerce would be the provision of the £100,000 to meet the initial expenses of establishment, mainly those of buying and equipping the premises; and has promised that once the college is established the Government will be prepared to make an annual grant of £10,000 or about one-third of the running cost. Most of the balance of the annual expenditure of £30,000 would be met from fees paid by local education authorities so that the college would be maintained largely out of public funds.

Why a college is needed. The Willis Jackson Committee considered that there is a need at the top level of the technical teaching profession for men with the breadth of outlook, attitude of mind and authority needed to exert a strong influence both within their own colleges and upon the industrial and commercial firms which they serve. Existing facilities for teacher training or for refresher courses cannot be expected to provide the kind of experience which a senior teacher requires to fit himself for posts of real responsibility.

The staff college would be a centre where carefully selected senior staff from the colleges could exchange information, ideas and experience by direct contact and personal discussion with their colleagues from other colleges and with personnel from industry and commerce, universities, government, overseas, and other associated fields. A good deal of experience in the operation of staff colleges of this kind has been gained in industry in recent years.

Size and scope. The college is intended to be a small one offering a series of short courses of 2-4 weeks throughout the year, the first of which, it is hoped, would start before the end of 1961.

The numbers attending each course would be kept low enough—probably not more than thirty—to permit each member to make a full contribution out of his own experience. It is desirable that about two-thirds of these should be experienced teachers, the rest being

a variety of people from associated fields—industrial education and training officers, personnel managers, works managers, research, production and sales staff, school and university staff, and so on.

Each course would be devoted to some different major topic of concern to the technical colleges, having to do with the development of teaching methods, the organization of new courses, the emergence of new technologies, and the administration and organization of the colleges.

There would be no 'instruction' in these subjects. The participants would come to pool their own ideas and experience and learn from one another. But there would have to be a nucleus of permanent staff.

How courses would be run. It is envisaged that the college would be a self-governing entity with its own governing body, consisting of representatives of industry and commerce, L.E.As and teachers.

The permanent staff, headed by a director of studies, would run the college under the guidance of the governing body, who would be responsible for the buildings, the appointment of staff, the programme of courses, administration, finance and general policy.

When the time comes to establish the governing body in consultation with the various organizations involved, the Minister hopes that Sir Alexander will be prepared to be the first chairman.

INDUSTRIAL TRAINING COUNCIL

The first report of the Industrial Training Council, covering the period July, 1958 to December, 1959, has recently been issued. The I.T.C. was set up in July, 1958 by the British Employers' Confederation, following the Report of the Carr Committee on the Recruitment and Training of Young Workers in Industry, 'to keep under review the recruitment and training of workpeople, to provide encouragement and help to industries in dealing with the training of workpeople, and to collect and disseminate information about aspects of training common to more than one industry, including information about training practices in other countries.'

In its first report the Council states that its immediate task is to try to ensure that industry's training arrangements will be adequate to enable the best use to be made of the abilities of all the young people who will be available for employment during the next few years. The Council sees its main function in this respect as the encouragement of the employers' organizations and trade unions to take the necessary action and to bring home their responsibility in this matter of training.

The major part of the report, therefore, is devoted to a summary of what the organizations have done so far in dealing with the problem of training the increasing number of school-leavers. About 60 industries, as represented mainly by various employers' organizations, have submitted brief reports as to how they are implementing the Carr Report, and these statements are summarized in the I.T.C. report.

Approved Names.—The General Medical Council has issued a supplementary list of Approved Names dated January, 1960. The list is available from the Secretary, British Pharmacopoeia Commission, 44 Hallam Street, London, W.1.

British Empire Chapel.—A service will be held in St Paul's Cathedral on 20 May for the purpose of dedicating the chapel of the Order. Those belonging to the Order and holders of the B.E.M. who wish to attend are invited to apply for a ticket to the Secretary of the Central Chancery of the Orders of Knighthood, 8 Buckingham Gate, London, S.W.1. Applicants are requested to state the class of appointment they hold.

Record Export of Drugs.—Exports of British drugs and medicines reached a record figure of over £40 million in 1959, an increase of £2·4 million over that for 1958. Well over a quarter of the pharmaceutical industry's production is now being exported.

Figures published by the Board of Trade show that Australia, Nigeria, the Irish Republic and New Zealand were the leading importers. Canada and the U.S.A. also show increased figures for last year. The largest specified group was antibiotics, followed by vitamins. Exports of alkaloids, aspirin and sulphonamides each exceeded £1 million in value.

President of Pakistan on Scientific Research.—Inaugurating the twelfth All-Pakistan Science Conference in Hyderabad recently, the President of Pakistan, Field Marshal Mohammed Ayub Khan, said that everything science had given to the world must be viewed in the context of its ultimate benefit to humanity. He continued: 'The earth is still there to yield its vast treasures, and man has yet to achieve those heights of moral and spiritual evolution which should justify the purpose of our existence on earth. Fear and want still haunt huge areas, reducing human life to the level of dumb, driven cattle, and in an age of space travel, synthetic food products and remarkable mechanical amenities, millions continue to live in isolation, hunger and primitive circumstances, making a mockery of all spiritual, material and intellectual enlightenment in which modern man takes reasonable pride.'

'That then is the challenge. . . . The technically non-proficient but necessity-conscious consumer can only point out his need and necessity. It is for the manufacturer to invent, adopt or adjust accordingly. Science must endeavour to evolve its own ethics, just as its counterparts in religion, philosophy, sociology, etc., have done. It must come from within; it cannot and must not be superimposed from without. That is the only way science can progress and prosper in the service of humanity.'

Obituary

Stafford Aston. *B.* 19.9.1875. *Ed.* University College School, London, 1887-92; University College, London, 1892-98. Whilst at University College he worked in the laboratory of Sir William Ramsay. On leaving he became for a time assistant to Otto Hehner, Public Analyst for Nottinghamshire, and later joined the firm of Cross and Bevan, with whom he remained until 1921. During the earlier part of his time there he assisted C. F. Cross in his research work which led to the development of artificial silk; later, most of his work was with E. J. Bevan, who was Public Analyst for the County of Middlesex. On Bevan's death, Aston was appointed his successor, which office, together with a later appointment under the Middlesex Insurance Committee, he filled until his retirement in 1942. (*A.* 1900, *F.* 1903.) *D.* 15.11.59.

Samuel Walter Atherley. *B.* 22.3.00. *Ed.* University College (now the University), Nottingham, 1916–18, 1919–21, interrupted by service in H.M. Royal Navy, 1918–19. B.Sc.(Lond.). He was appointed successively works chemist, F. H. & H. S. Pochin Ltd, Leicester, 1922; works chemist, Saltrates Ltd, London, 1923; works chemist, William Wren & Co. Ltd, Northampton, for 6 months during 1927; chemist and works manager, Johnson & Johnson (Gt Britain) Ltd, Slough, 1927; and finally works chemist, Dalmas Ltd, Leicester, where he remained for the rest of his life. He became works manager in 1930, and chief chemist and works director in 1941. He gave valuable service to the East Midlands Section of the Institute from 1941 to the time of his death and was its chairman from 1945 to 1947, followed by 4 years as honorary auditor. His main hobby was gardening; he was a keen Mason and a staunch Rotarian. (*A.* 1921, *F.* 1943). *D.* 22.10.59.

Bertram Alfred Bull. *B.* 20.12.1884. *Ed.* Wyggeston Boys' School, Leicester; London School of Pharmacy, 1906–07, where he was a Pereira Medallist. He was an analyst and works chemist at John Richardson & Co., Leicester, Ltd, 1899–1906. Thereafter he became technical chemist, Records Department, Burroughs Wellcome & Co., 1907; manager, The English Pharmacy, Nairobi, British East Africa, 1911; works chemist, Timothy White & Co. Ltd, Portsmouth, 1914. He joined Boots Pure Drug Co. Ltd, Nottingham, the following year and became manager of the pharmaceutical laboratory in 1919. He was appointed a director in 1932 and when he retired from executive duty in 1946 he was Pharmaceutical Production Manager. He retained his seat on the board until 1955. He was chairman of the committee which planned the Beeston factories of the company, as well as chairman of the British Pharmaceutical Conference in 1946 and 1947. He served on committees of the British Pharmacopoeia Commission and of the Codex Revision Committee, and represented the Pharmaceutical Society on the Poisons Board and on the first Joint Formulary Committee. (*A.* 1919.) *D.* 15.11.59.

Thomas Howard Butler. *B.* 13.1.1887. *Ed.* University College (now the University), Bristol, 1904-06; University of Jena, 1906–09. M.Sc. (Bris.), Ph.D. (Jena). In 1909 he joined William Butler & Co. (Bristol) Ltd, which his grandfather founded in 1843. He became a director in 1917, managing director in 1921, and was chairman from 1935 until his retirement in 1959. He was also a director of a number of other firms. During the Second World War he was a member of the Advisory Committees of the Coal Tar Control under the Ministry of Fuel and Power and a member of the manpower board representing the Board of Trade under the Ministry of Labour. He served as president of the Association of Tar Distillers (1921), president of the Bristol Tar Federation (1948), and master of the Worshipful Company of Paviors (1952). His services to hospitals in the Bristol area were many and varied, culminating in his appointment as deputy chairman of the South Western Regional Hospital Board in 1958. (*F.* 1918.) *D.* 1.11.1959.

Leslie George Cottrall. *B.* 21.10.1892. *Ed.* King's College School, Wimbledon; King's College, London, 1910-13. B.Sc. After serving in H.M. Forces during the First World War, he was appointed in 1919 a mill chemist to Albert E. Reed & Co. Ltd (now the Reed Paper Group) at Horton Kirby Paper Mill. He was transferred to Aylesford as chief chemist in 1923 and during the next 23 years was responsible for the expansion of the Technical Division, of which he became Chief in 1946. For a few months during 1958 he was Technical Consultant to the newly formed Paper and Board Division prior to his retirement later the same year. He was widely known for his activities outside the Group and was made an honorary member of the Technical Section of the British Paper and Board Makers' Association in 1958, of which he had been a member since 1923, serving as chairman, 1946-48. He served also on a number of technical committees, and was the author of *Introduction to Stuff Preparation for Paper Making*, as well as of papers in the technical press. (*A.* 1917, *F.* 1939.) *D.* 4.12.59.

John Cross. *B.* 13.1.00. *Ed.* University of Sheffield, 1916–18, 1919–22 (interrupted by war service). A.Met. On his release from military service, he accepted a post in the chemical laboratory of Dr F. Rogers, consulting metallurgist and engineer, with whom he had spent a few months in 1916. He relinquished this post in 1925 to take up an appointment as assistant analyst in the Naval Ordnance Department of the Admiralty, and was promoted to the grade of chemist in 1936. He became

chemist in charge of the Admiralty Chemical and Metallurgical Inspection Centre in the University of Glasgow in 1940. He was transferred to London in 1945 and remained with the Admiralty until the time of his death, when he was a senior principal scientific officer in the Department of Engineering and Materials Research. (*A.* 1931, *F.* 1944.) *D.* 1.11.59.

David Smart Gracie. *B.* 12.1.1897. *Ed.* University of Edinburgh, 1918-23. B.Sc.Agric. He volunteered for service in the Royal Scots at the age of 17, and was badly wounded on the Somme in 1916. He spent the rest of the First World War as a prisoner in Germany, an experience which marked him for life. After graduating at Edinburgh, he became a lecturer in agricultural chemistry, firstly under Cheshire County Council, and later at the Edinburgh and East of Scotland College of Agriculture. In the late twenties he joined the Colonial Service and carried out a preliminary survey of the soils of Kenya. Moving to the Egyptian Ministry of Agriculture in 1930, he spent two decades investigating the problems presented by a soil which has sixty centuries of cultivation history. D.Sc.(Edin.), 1950. He started afresh the same year locating cultivable areas in the Jordan valley for the United Nations Arab Relief. In 1955 he transferred to Iran, where he created a large efficient laboratory organization for the United Technical Assistance Board at Teheran. His health failed in 1958 and he retired to his Edinburgh home. 'Human, kindly, generous and considerate, his friendship was one of the wholly good things a man could be blessed with.' (*A.* 1924, *F.* 1950.) *D.* 31.5.59

Eric John Holmyard. *B.* 11.7.1891. *Ed.* Sexey's School, Bruton; Sidney Sussex College, Cambridge, 1908–13. M.A.(Cantab.), M.Sc., D.Litt.(Bris.). After serving one year as an assistant demonstrator in chemistry in the University of Cambridge, he became a development scholar in agriculture at Rothamsted Experimental Station in 1913. The following year he was appointed head of the science department at Bristol Grammar School. He left in 1917 to become science master at Marlborough College and two years later became head of the science department at Clifton College, Bristol.

His textbooks for schools were world-famed for more than two decades. He became Scientific Editor, J. M. Dent & Sons Ltd, 1928–44, and subsequently Science Editor, Everyman's Encyclopaedia, and latterly, Penguin Books Ltd. He was for many years a Membre Correspondant de l'Académie Internationale de l'Histoire des Sciences and Chairman, World List of Scientific Periodicals. Among his interests were walking, travel and golf, and he was well known for his interest in horse-shows. He joined Imperial Chemical Industries Ltd in 1940 as first Editor of its international scientific review, *Endeavour*, remaining in that capacity until his retirement in 1954. He established for himself a unique position as a scientific historian, particularly in the field of alchemy and Muslim chemistry, culminating in a major contribution to international scholarship as co-editor of the five-volume *History of Technology*, the final volume of which appeared in 1958. He also took a prominent part, as Chairman of the Society for the Study of Alchemy and Early Chemistry, in the encouragement of historical research, and his *Alchemy* (Penguin Books) ranks high in the literature of the subject. 'He was open and friendly, and in whatever company he found himself his quiet charm and delicate sense of humour, wholly free from malice, endeared him.' (*F.* 1924.) *D.* 13.10.59.

James Houston. *B.* 25.10.13. *Ed.* College of Technology, Belfast; Queen's University, Belfast, 1931-34. B.Sc. He remained at the University a further two years and was awarded the degree of M.Sc. After a short period in the Department of Biochemistry, Reading, he was appointed a research assistant in the National Institute for Research in Dairying, Reading, in 1938, and thereafter became successively experimental officer, Chemical Inspection Department, Ministry of Supply, 1941; biochemist, Liverpool Heart Hospital, 1943; and senior assistant to the County Analyst, Worcestershire County Council, 1944. After the introduction of the National Health Scheme, he returned to biochemistry and became senior biochemist at the Royal Infirmary, Doncaster, in 1949. He took a similar post at the Nottingham General Hospital in 1952, and was appointed biochemist at the Royal Northern Hospital, London, in 1955, a post which he held at the time of his death. He was co-author of a number of papers. (*A.* 1949.) *D.* 7.9.59.

John Hughes. *B.* 27.12.15. *Ed.* Royal Technical College, Salford, 1931–34; College of Technology, Manchester, 1937–40. His first appointment was as assistant chemist to Greengate & Irwell Rubber Co. Ltd, in 1935. Thereafter he became successively chemist, Rubber Regenerating Co. Ltd, 1937; chief chemist, Rubber Latex Co. Ltd, 1946; chief chemist, J. Robertson & Co. Ltd, 1947; product development chemist, Colgate-Palmolive Ltd, 1948, later becoming Head of the Product Development Section; and chief chemist, F. W. Hampshire & Co. Ltd, 1956, a post which he held at the time of his death. (*A.* 1957.) *D.* 22.7.59.

Nicholas Miller. *B.* 4.7.16. *Ed.* Imperial College, London, 1935-37. B.Sc., Ph.D. He obtained a Commonwealth Fund Fellowship in 1939 and proceeded to the University of California and California Institute of Technology. He took an appointment connected with chemical warfare in the Department of National Defence, Canada, in 1941, and was transferred to work in atomic energy for the National Research Council of Canada in 1943. He was awarded an I.C.I. Fellowship

in the University of Edinburgh in 1946 and was appointed senior lecturer in radiochemistry in the same university in 1949, a post which he held at the time of his death. (*F.* 1955.) *D.* May, 1958.

John Arnold Mitchell. *B.* 3.4.1887. *Ed.* University of Leeds, 1906–10; Chelsea Polytechnic, 1931–37. M.Sc.(Leeds), Ph.D.(Lond.). His first appointment was as part-time assistant lecturer in physics at the Storey Institute, Lancaster. The following year he became science lecturer at the Technical School, Bath. He served in H.M. Forces, 1915–19, and on his release, was appointed lecturer in chemistry at the Polytechnic, Regent Street, London, where he remained until his retirement. He was a contributor to the *J. chem. Soc.* (*F.* 1941.) *D.* 25.7.59.

Albert Charles Rich. *B.* 25.8.09. *Ed.* Private study and Acton Technical College. M.Sc.Econ.(Lond.). He became successively an assistant chemist to Palmer & Co. Ltd, London, in 1925; chemist to the Horton Manufacturing Co. Ltd, Rickmansworth, in 1930; chief chemist and departmental manager, Wilkins Campbell & Co. Ltd, West Drayton, in 1931. Later he was general manager of Gospo Ltd for a short time before joining Urwick, Orr and Partners in 1948 as a management consultant, a post which he held until the time of his death. He was the author of a number of articles in the technical press. (*A.* 1943.) *D.* 6.1.59.

CORRESPONDENCE

REMUNERATION OF CHEMISTS

SIR,—While in general one cannot fail to appreciate the achievement represented by your latest Remuneration Survey (*J.*, 1959, 485), is it not more likely to be, on balance, a source of frustration than of encouragement to us? It may stand for a long time as a social document, but it is pertinent to enquire whether the Institute endorses its introduction as evidence in salary negotiations.

For example, it is being politely ignored in the laboratories of one of the largest Blue Chip concerns, and men at age 45/50 in responsible senior positions are now confronted with a salary 'ceiling' which is over £200 below your *Lower* Quartile for Industry.

One may be accused of dramatizing the bitterness of cases of once-alert and valued employees tactlessly told that Service now counts for nothing, and whose paths are very liberally strewn both with the unqualified who are doing very nicely, and the stream of off-beat trainees who are now such a colourful ingredient of big business.

Potential recruits for Chemical Industry, and more particularly for laboratory work, should be warned that they will not enjoy for ever the smiles of a short-supply situation. And if they imagine that hard work will get them to the Board Room they must learn the hard way.

It might be discreet, and very appropriate if, with your permission, I sign myself,

RUSSELL SQUARE

The Publications Committee thanks all those members and interested readers who have written to express their views on the new *Journal* format. It is gratifying to discover that the majority have welcomed the changes. The relatively few criticisms and suggestions have been carefully noted for the future.

The Committee hopes that readers will not overlook the existence of the Correspondence column, which was initiated to further discussion primarily of professional and educational matters of topical interest. Letters should be addressed to the Editor and marked 'For publication' if so intended.

THE REGISTER

NEW FELLOWS

(M) CHAPMAN, Professor Norman Bellamy, M.A., PH.D. (CANTAB.)
(R) DODD, Eric Norman, B.SC., PH.D. (LOND.)
(P) HOLLIDAY, Leslie, M.A., B.SC. (OXON.), M.I.CHEM.E.
(O) HOWARD, George Alfred, M.SC. (MANC.), PH.D. (CANTAB.)
(P) MATHIESON, David Watson, B.SC. (GLAS.), PH.D. (LOND.)
(G) MORTON, Thomas Henry, M.SC. (BIRM.), PH.D. (CANTAB.), F.T.I., F.S.D.C.

ASSOCIATES ELECTED TO THE FELLOWSHIP

(P) BORN, Renate Ursula, B.SC. (GLAS.)
(P) CROFTS, John Bruce, B.SC. (LOND.)
(P) DAVIS, Joan, B.SC. (LOND.)
(N) ENTWISTLE, Norman, M.SC., PH.D. (MANC.)
(D) FOX, Bernard Victor
(K) GRAY, Joseph Wylie, A.M.INST.F.
(P) HILL, Derek Alfred Wheeler, B.SC., PH.D. (LOND.)
(P) KIMBER, Kenneth George, B.SC. (LOND.)
(Q) MITCHELL, John, B.SC. (LOND.)
(X) PARMELLA, Ralph
(Y) ROOK, John Allan Fynes, B.SC. (WALES), PH.D. (GLAS.)
(EE) SCOTT, Peter Alan Arthur, B.SC., PH.D. (LOND.)
(Q) SKELLY, James Kenneth, M.SC., PH.D. (BELF.), F.S.D.C.
(OB) SYKES, Robert Leonard, B.SC., PH.D. (LEEDS)
(R) WHEATLEY, Kenneth Harold, B.SC., PH.D. (LOND.)
(P) WILLIAMS, David Griffith, B.SC. (WALES), DIP.ED.

NEW ASSOCIATES

(P) ALEXANDER, Thomas Robert, B.SC. (LOND.)
(Q) BOFFEY, Brian John, B.SC., PH.D. (SHEFF.)
(B) CLARKE, Mary Jane Tannahill, B.SC. (BELF.)
(P) FISH, Hugh, B.SC. (LEEDS), M.INST.S.P.
(P) FRANCIS, Neil Robert, B.SC. (NOTT.)
(B) HAGEN, James, B.SC. (BELF.)
(E) HUGHES, William John, B.SC. (WALES), DIP.ED., PH.D. (CANTAB.)
(H) HUMPHRIES, Alan, B.SC.TECH., PH.D. (MANC.)
(B) NELSON, Samuel Martin, M.SC. (BELF.), D.PHIL. (OXON.)
(P) NICHOLLS, David, B.SC., PH.D. (S'TON)
(B) REID, Robin Denis, B.SC. (BELF.)
(P) ROSELAAR, Leonard Cyril, M.A. (OXON.), PH.D. (LOND.), D.I.C.
(P) SMITH, Brian Vellender, B.SC., PH.D. (LOND.)
(P) SMITH, Raymond John, B.SC., PH.D. (LOND.)
(P) WALKER, Derek Alfred, B.SC. (LOND.)
(P) WHITEHEAD, David Charles, B.SC. (R'DG)
(Y) WRIGHT, Walter William, B.SC., PH.D. (BIRM.)

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

(SS) BANNISTER, Kathleen Mary, B.SC. (MANC.)
(Q) BARKER, Sidney
(P) BARNETT, Peter Jonathan, B.A. (CANTAB.)
(S) BLACKBURN, Robert, B.SC. (DUNELM.)
(C) BROTHERTON, Janet, B.SC. (BIRM.)
(C) BROWNING, David Robert, A.R.T.C.S.
(G) CALLIS, Alfred Benton
(U) COKE, John Royston, B.SC. (LOND.)
(N) COOP, William, B.SC. (BIRM.)
(J) DRUMMOND, Donald William, A.H.-W.C.
(A) FREEMAN, Alan George, A.C.T. (BIRM.)
(D) GILES, John Anthony
(P) GOODSON, Leslie Alan, B.SC. (LOND.)
(P) JOHNSON, Derek Ivor Oliver
(C) JOHNSON, Peter, B.SC. (BIRM.)
(J) KEAY, James Alexander, A.H.-W.C.
(E) MACIVER, Donald Roderick, A.H.-W.C.
(SS) MASSEY, Alan Gibbs, B.SC., PH.D. (LIV.)
(L) MILNES, Malcolm Howard
(C) MORGAN, Peter Ernest
(K) NEIL, Archibald
(H) PENTELOW, John Edward, B.A. (CANTAB.)
(L) SCHORFIELD, David Stuart, B.SC. (LOND.)
(O) STEWARD, Keith William Frederick, A.C.T. (LIV.), B.SC. (WALES)
(O) WALLEY, John Frederick, D.L.C., DIP.CHEM.ENG. (LOND.)
(P) WELLS, Frederick Bernard Graham, B.SC. (LOND.)

NEW GRADUATE MEMBERS

(C) BEANEY, Peter Austin, DIP.TECH. (BIRM.)
(SS) BROWN, Thomas Carlyle, A.R.C.S.T. (GLAS.)
(S) BURDETT, Keith, B.SC. (BIRM.)
(P) CHESHIRE, John David, B.SC. (LOND.)
(P) CROPP, John Anthony David, B.A. (CANTAB.)
(E) GIDDINGS, David George, B.SC. (WALES)
(R) HALLAM, Anthony Peter, B.A. (CANTAB.)
(C) HOMER, John, B.SC. (LEEDS)
(P) ORVIS, Michael John, B.A. (CANTAB.)
(SS) SMITH, Geoffrey Harold, B.SC. (SHEFF.)
(Q) TABBRON, Geoffrey, M.SC. (LEEDS)
(K) TAIT, Alexander Dickson, A.R.C.S.T. (GLAS.)
(P) TWAITS, Robert, B.SC. (LOND.)
(P) WALKER, Michael Sanderson, B.SC. (LOND.)
(P) WESTMORE, John Brian, B.SC. (LOND.)
(Q) WILDE, Colin Ernest, B.SC. (BIRM.)

CHANGE OF NAME

Patrick JELLEY to SEBELL

DEATHS

Fellows

(C) CADMAN, William Henry, M.B.E. (MIL.), B.SC. (WALES). Died 20 February, 1960, aged 79. *A.* 1921, *F.* 1926.
(K) CAW, William. Died 8 February, 1960, aged 71. *A.* 1911, *F.* 1914.
(W) GATES, Charles Gordon, B.SC. (LOND.). Died 13 December, 1959, aged 75. *A.* 1906, *F.* 1909.
HAMBLY, Frederick John. Died 2 February, 1960, aged 91. *F.* 1892.
(X) JACKSON, Ernest Wilfrid. Died November, 1959, aged 80. *F.* 1919.
(X) JARMAN, Maurice Bevan, M.A., B.SC. (OXON.). Died 4 January, 1960, aged 53. *A.* 1931, *F.* 1946.
(N) WELLS, Ernest Edmund, B.SC. (LOND.). Died 26 January, 1960, aged 70. *A.* 1916, *F.* 1922.

Associates

(O) EDWARDSON, Joseph Norman. Died 14 November, 1959, aged 54. *A.* 1938.
(W) REID, John Wardlaw. Died 9 February, 1960, aged 65. *A.* 1926.
(P) TAYLOR, Geoffrey Lawrence. Died 9 February, 1960, aged 26. *A.* 1954.

LOCAL SECTIONS DIARY

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated.

(B) **Belfast.** 5–8 April. Joint Anniversary Meetings of Institute and Chemical Society. Dept. Chem., Queen's University
(X) **Billingham.** 24 Mar. 8. Organic Chemistry of Ferrocene. Prof. P. L. Pauson. Stockton and Billingham Technical College. Joint, C.S.
(O) **Birkenhead.** 28 April. 7. Flash Photolysis and the Study of Fast Reactions. Prof. G. Porter. Technical College, Borough Road
(C) **Birmingham.** 30 Mar. 6.30. A.G.M. College of Advanced Technology, Gosta Green
(SS) **Blackburn.** 31 Mar. 7.30. A.G.M. followed by lecture on Wines. G. Osgood. Technical College
(G) **Colchester.** 29 Mar. 7.30. Forensic Science. Dr I. G. Holden. N.E. Essex Technical College
(T) **Connah's Quay.** 27 April. 7.30. Intermetallic Chemistry. Prof. W. Hume-Rothery. Flintshire Technical College
(F) **Cork.** 29 April. 8. Lecture Tour: Some Recent Developments in Explosions. Dr J. Craik. University College
(P) **Dartford.** 31 Mar. 7. Film Show. N.W. Kent College of Technology, Miskin Road
(F) **Dublin.** 30 Mar. 7.45. The Physico-Chemical Investigation of Some Inorganic Complexes. Dr W. J. Davis. Trinity College
—— 27 April. 5.30. (See Cork.) University College.
(FF) **Dundee.** 18 Mar. 7.15. Scientific Control in Confectionery Manufacture. D. R. Brown. Technical College.
—— 22 April. 7.15. Chemical Applications of Electronic Digital Computers. Dr E. T. Stewart. Queen's College
(J) **Edinburgh.** 31 Mar. 7.30. A.G.M. North British Hotel
(W) **Exeter.** 25 Mar. 4. A.G.M. followed by an address. E. Le Q. Herbert. Washington Singer Laboratories
(R) **Fawley.** 2 April. 10.30 a.m. Symposium on the Disposal of Industrial Wastes. Esso Refinery
(F) **Galway.** 2 May. (See Cork.) University College
(L) **Huddersfield.** 25 Mar. 6.45. A.G.M. followed by Physical Chemistry in Organic Chemicals Industry. Dr D. S. Davies. Alexandra Chambers, John William Street
(M) **Hull.** 28 April. 6.45. A.G.M. followed by Chemical Background to Colour Photography. Dr G. I. P. Levenson. The University
(O) **Liverpool.** 7 April. 6.15. A.G.M. followed by Medicine's Debt to Chemistry. Lord Cohen. Donnan Laboratories, The University
(P) **London.** 25 April. 6.30. Ladies' Evening: Laundering Modern Fabrics. J. Leicester and F. R. Hill. Royal Institution, Albemarle Street, W.1
(P) **Luton.** 7 April. 8. Organic Syntheses using the Enzyme Peroxidase. Dr B. C. Saunders. College of Further Education, Park Square
(Q) **Manchester.** 24 Mar. 10.30 a.m. Symposium on Olefines in the Petroleum Industry. The University. Joint, C.S., S.C.I. and Inst. Pet.
—— 13 April. 7.15. Ladies' Evening: Textiles Today. J. G. Evans. College of Science and Technology
(E) **Newport.** 22 April. 7. Film Show. King's Head Hotel. Joint, S.C.I.
(C) **Northampton.** 6 April. 7. Some Physico-chemical Problems of Semiconductor Physics. Prof. G. F. J. Garlick. College of Technology
(H) **Nottingham.** 24 Mar. 7.30. A.G.M. followed by Cancer Research. Dr B. W. Langley. Notts and District Technical College
(R) **Poole.** 26 April. 7.30. Lubrication. J. E. James. Generating Station. Joint, Poole Technical Group
(O) **St Helens.** 24 Mar. 7. Glass and the Periodic Table. Dr A. Cousen. Technical College
(R) **Salisbury.** 24 Mar. 7.45. Chemicals Aids to Better Crops. G. L. Baldit. Cathedral Hotel. Joint, Salisbury Field Club
(EE) **Seascale.** 8 April. 8. A.G.M. followed by Some Analytical Chemistry Problems in Atomic Energy. G. W. C. Milner. Windscale Club
(U) **Sheffield.** 1 April. 7. How Soaps and Detergents Work. Dr A. S. C. Laurence. The University
(T) **Shotton.** 13 April. 2. Visit to Hawarden Bridge Steel Works
(V) **Swansea.** 29 April. 7.30. A.G.M. Mackworth Hotel

MANCHESTER SYMPOSIUM ON THE INDUSTRIAL CHEMISTRY OF THE LOWER OLEFINES

The annual Conjoint Symposium of the Chemical Society, the Institute of Petroleum, the Society of Chemical Industry and the Institute will be held in the Chemistry Lecture Theatre, The University, Manchester, on Thursday, 24 March.

PROGRAMME

10.30 *a.m.*–12.45 *p.m.*

The Economics of Ethylene Production from Naphtha, by J. Chrones and J. L. James (Kellogg International Corporation);
The Production of Ethylene Oxide, by R. P. van Oosten (Bataafse Internationale Chemi Maatschappij).

2.30 *p.m.*–4.15 *p.m.*

Industrial Chemicals Based on Ethylene and Propylene, by Dr A. F. Millidge (Distillers Co. Ltd.);
Production and Utilization of Butadiene, by A. A. Appleton (Esso Petroleum Co. Ltd).

5 *p.m.*–6.30 *p.m.*

Newer Developments in the Polymerization of Olefines, by Professor C. E. H. Bawn, F.R.S. (University of Liverpool).